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TREASURY DEPARTMENT.

MORTALITY STATISTICS

IN THE

UNITED STATES

FOR THE

YEAR ENDING DECEMBER 31, 1897.

(FROM ANNUAL REPORT MARINE-HOSPITAL SERVICE, 1898.)

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN UNITED STATES FOR THE TWELVE MONTHS ENDED DECEMBER 31, 1897.

[illegible]	Total [illegible] from all	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.
Alabama:										
Avondale	25	1,642	2,500	10	4	...	...	...	...	...
Birmingham	509	26,178	35,000	14.54	99	1	11	1	1	6
Brewton	20	1,115	2,000	10	1	...	1	...	...	...
Decatur	37	2,765	3,000	12.33	7	...	1	...	...	...
Evergreen	15	1,783	2,152	6.97	1	...	...	...	...	...
Gadsden	31	2,901	5,000	6.20	2	...	1	...	...	...
Greenville	23	2,806	3,000	7.66	2	...	1	...	...	...
Mobile	916	31,076	37,817	23.92	108	...	20	...	1	1
Oxford	16	1,473	2,000	8	...	...	1	...	...	1
Ozark	11	1,195	2,200	5	3	...	3	...	...	...
Selma	123	7,622	7,622	16.13	10	...	2	...	...	...
Talladega	212	2,063	29,346	7.22	27	...	13	...	3	2
Troy	64	3,449	4,000	16	4	...	4	...	...	1
Tuscaloosa	74	4,215	5,000	14.80	15	...	8	...	...	...
Woodlawn	12	1,506	3,000	4	2	...	...	...	...	...
Total	2,088	...	143,637	14.53	285	1	66	1	5	11
Arizona:										
Bisbee	22	1,535	3,000	7.30	...	...	5	...	...	3
Tucson	133	5,150	9,000	14.70	41	...	1	...	...	3
Total	155	...	12,000	12.92	41	...	6	...	...	6
Arkansas:										
Harrison	25	1,438	1,800	13.89	1	...	1	...	...	...
Magnolia	50	1,486	2,000	25	1	...	12	...	...	...
Total	75	...	3,800	19.74	2	...	13	...	...	...
California:										
Bakersfield	127	2,626	3,000	42.33	10	...	1	...	...	1
Colton	24	1,315	2,500	9.60	...	...	...	...	...	...
Colusa	16	1,336	2,000	8	3	...	1	...	...	...
Dixon	25	1,082	2,000	12.50	5	...	...	...	...	2
Eureka	91	4,858	8,000	12	...	...	...	...	1	...
Marysville	99	3,991	5,000	19.80	23	...	3	...	...	2
Merced	16	2,009	2,000	8	5	...	...	...	...	...
Napa	30	4,395	4,000	7.50	11	...	2	...	...	...
Oakland	768	48,882	75,000	10.24	108	...	9	3	1	8
Pacific Grove	5	1,336	1,400	3.57	...	...	...	...	...	1
Pasadena	132	4,882	10,000	13.20	30	...	2	...	5	1
Pomona	118	3,634	7,500	15.73	26	...	2	...	1	...
Redlands	65	1,904	4,500	14.44	33	...	...	...	1	...
Sacramento	444	26,386	30,000	14.80	67	...	3	4	...	9
San Bernardino	63	4,012	9,000	15.55	19	...	1	...	1	3
San Diego	310	16,159	22,000	14.90	34	...	1	...	...	1
San Francisco	6,153	298,997	360,000	17	868	...	58	12	5	100
San Jose	288	18,060	25,000	11.50	49	...	4	5	6	...
Santa Ana	159	3,628	10,000	15.90	28	...	9	1	...	3
Santa Barbara	156	5,864	6,700	...	26	...	7	...	...	...
Santa Clara	34	2,891	3,100	10.96	6	...	...	...	...	...
Santa Cruz	91	5,596	8,000	...	15	...	2	...	...	2
Santa Paula	36	1,047	2,000	18	10	...	...	...	...	...
Vallejo	100	6,343	7,500	...	3	...	...	2	...	7
Visalia	40	2,885	4,000	10	10	...	...	...	...	...
Willows	15	1,176	1,500	10	...	...	...	...	...	...
Total	9,405	...	615,700	15.28	1,389	...	65	27	21	142
Colorado:										
Canyon	52	2,825	6,000	8.66	...	...	2	...	...	...
Colorado Springs	282	11,140	22,000	13.70	103	...	10	2	3	...
Denver	1,838	106,713	160,000	11.40	461	...	63	22	10	45
Greeley	28	2,395	3,500	8	1	...	1	...	...	3
Longmount	37	1,543	2,500	10.80	9	...	1	1	...	4
Pueblo	408	24,558	40,000	10.20	...	...	7	2	7	7
Rico	6	1,134	1,000	6	...	...	...	...	...	...
Trinidad	36	5,523	6,000	6	...	...	4	2	1	...
Total	2,687	...	241,000	11.15	574	...	88	29	21	59

BLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
nnecticut:											
Avon	12	1,182	1,200	10	....	....	....	....	....	1	....
Bethel	38	3,401	3,600	10.50	4	....	1	....	....	1	....
Berlin	41	2,600	3,000	13.60	5	....	....	....	....	1	1
Bozrah	11	1,005	1,000	11	....	....	....	....	....	....	....
Bridgeport	1,004	48,866	65,000	15.40	119	....	15	....	3	33	28
Brooklyn	57	2,628	2,628	21.60	6	....	2	....	1	1	1
Burlington	24	1,302	1,300	18.40	1	....	....	....	....	....	....
Canton	46	2,500	2,600	17.60	4	....	....	....	....	....	....
Cheshire	28	1,929	1,850	15.10	2	....	....	....	....	3	....
Chester	16	1,301	1,300	12.80	3	....	....	....	....	....	....
Colchester	43	2,988	2,200	19.50	15	....	....	....	....	....	....
Colebrook	17	1,098	1,000	17	....	....	....	2	....	....	....
Coventry	33	1,875	1,775	18.50	2	....	1	....	....	....	....
Danbury	296	16,552	20,000	14.80	20	....	1	2	1	8	1
Darien	37	2,276	2,400	15.40	2	....	....	....	....	1	....
East Haddam	39	2,509	2,500	15.60	7	....	....	....	....	....	....
East Windsor	47	2,890	2,890	16.20	5	....	2	....	....	1	....
Essex	34	2,035	2,000	17	5	....	....	....	....	....	....
Fairfield	85	3,868	3,900	21.76	6	....	1	2	2	1	....
Farmington	56	3,179	3,500	16	3	....	....	....	....	....	....
Griswold	71	3,113	3,800	18.68	10	....	1	....	....	3	....
Haddam	34	2,095	2,000	17	1	....	1	....	....	....	....
Hartford	1,155	53,230	72,000	16.04	....	....	19	1	3	18	18
Hebron	14	1,039	1,000	14	2	....	....	....	....	1	....
Litchfield	42	3,304	3,500	12	4	....	....	....	....	....	....
Madison	27	1,429	1,400	19.21	1	....	1	1	....	....	....
Mansfield	38	1,911	1,900	20	....	....	....	....	....	....	....
Milford	51	3,811	4,000	12.75	1	....	....	....	....	2	....
New Hartford	44	3,160	3,890	11.31	....	....	....	....	....	....	....
New Haven	1,768	81,298	110,000	16.07	214	....	25	9	19	89	4
Norfolk	24	1,546	1,600	15	2	....	....	....	....	....	....
North Haven	27	1,862	2,000	13.50	1	....	1	....	....	....	....
North Stonington	27	1,463	1,400	19.28	2	....	....	....	....	....	....
Old Lyme	13	1,319	1,350	9.63	2	....	....	....	....	....	....
Old Saybrook	24	1,484	1,500	16	....	....	....	....	....	....	....
Orange	89	4,537	6,000	14.83	....	....	....	....	....	....	....
Plymouth	37	2,147	2,400	15.41	4	....	....	....	....	....	....
Rocky Hill	14	1,069	1,100	12.72	2	....	....	....	....	....	....
Seymour	38	3,300	3,300	11.51	4	....	1	....	....	....	....
Sharon	45	2,149	2,580	17.43	1	....	....	....	....	....	....
Simsbury	24	1,874	2,000	12	1	....	....	....	....	....	....
Sprague	12	1,106	1,050	11.42	1	....	....	....	....	....	....
Southbury	14	1,089	1,100	12.72	....	....	....	....	....	....	....
Stamford	347	15,700	18,500	18.75	38	....	3	....	3	19	....
Stonington	130	7,184	7,500	16	15	....	....	....	1	....	....
Stratford	57	2,608	3,500	16.28	8	....	....	....	....	....	....
Suffield	56	3,169	3,200	17.50	2	....	....	....	....	....	....
Tolland	17	1,037	1,100	15.45	....	....	....	....	....	....	....
Trumbull	20	1,453	1,500	13.33	....	....	....	....	....	....	....
Vernon	121	8,808	8,500	14.23	6	....	1	....	1	....	....
Waterbury	747	28,646	42,000	17.54	72	....	15	3	5	42	5
Watertown	37	2,323	2,800	13.21	....	....	1	....	....	....	....
Westport	68	3,715	4,000	17	11	....	....	1	1	1	....
Wethersfield	37	2,271	2,400	15.41	3	....	....	....	....	....	....
Wilton	36	1,722	1,700	21.17	11	....	....	....	....	....	....
Winchester	114	6,183	8,000	14.25	6	....	3	....	1	2	....
Woodbury	24	1,815	2,000	12	1	....	....	....	....	....	....
Total	7,407	....	463,613	15.98	635	....	94	21	41	228	56
Delaware:											
Milford	61	1,226	3,446	17.70	....	....	....	....	....	1	....
Wilmington	1,322	61,431	72,500	18.23	114	....	23	....	2	96	3
Total	1,383	....	75,946	18.21	114	....	23	....	2	97	3
District of Columbia:											
Washington	5,486	230,392	280,250	19.57	724	....	121	2	....	125	111
Total	5,486	....	280,250	19.57	724	....	121	2	....	125	111

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Florida:											
Apalachicola	44	2,727	3,500	12.57	2			1			
Fernandina	81	2,803	3,500	23.14	11		2	2		2	
Jacksonville	606	17,201	30,000	20.20	83		8			1	
Key West	500	18,080	20,000	25	73		16			7	1
Ocala	*a* 60	2,904	4,000	15	9		3				
Pensacola	*b* 180	11,750	15,000	12	4		12			1	
Warrington	13	1,301	1,200	10.83							
Total	1,484		77,200	19.23	182		41	3		11	1
Georgia:											
Americus	140	6,398	10,000	14					2	1	
Carrollton	24	1,451	3,000	8	2		2				
Cartersville	25	3,171	3,500	7.14		1					
Columbus	245	17,303	19,303	12.69	38		7		1	3	
Covington	14	1,823	2,200	6.36	4					1	
Darien	16	1,491	2,000	8	3						
Dawson	33	2,284	3,000	11	1					1	
Decatur	16	1,013	2,000	8							
Fort Gaines	12	1,097	1,600	7.50							
Fort Valley	50	1,752	1,700	29.41	2						
Greensboro	8	1,313	1,750	4.57	2						
Lagrange	24	3,090	2,200	11.81	1		6			1	
Lithonia	20	1,182	1,500	13.32	4		1				
Macon	240	22,746	28,000	8.59		1					
Newnan	207	2,859	5,000	41.40	9		5			6	
Roswell	13	1,138	1,200	10.83	5					2	
Savannah	1,314	43,189	70,000	18.77	157		23	1		8	7
Sparta	2	1,540	1,800	1.11							
Thomaston	5	1,181	2,000	2.50			2				
Thomasville	98	5,514	6,000	16.33	9		3				
Way Cross	39	3,364	7,000	5.55	5		3				
Total	2,547		174,753	14.57	242	2	52	1	3	23	7
Idaho:											
Boise City	70	2,311	7,000	10							
Montpelier	6	1,174	1,200	5							
Total	76		8,200	9.27							
Illinois:											
Abingdon	31	1,321	2,500	12.40						1	
Altamont	40	1,044	1,800	22.22	3		1			2	
Astoria	13	1,357	2,000	6.50	3		2			2	1
Aurora	280	19,688	28,000	10	10		10	6	3	13	
Belleville	204	15,361	20,000	10.20	19		7		1	1	
Braceville	21	2,150	1,500	14	1			1		3	1
Bunker Hill	20	1,269	1,400	14.28	2		1	1		1	
Bushnell	28	3,314	3,000	9.33	4		2			3	
Cable	6	1,276	1,200	5.00							
Camp Point	12	1,150	1,300	9.15	1						
Carrollton	80	2,258	2,800	28.59					1		
Champaign	125	5,839	9,000	13.88							
Charleston	41	4,135	7,500	5.46			5			4	
Chenoa	9	1,226	1,800	5.00	4					1	
Chicago	21,809	1,099,850	1,619,226	13.40	2,180		437	139	81	702	160
Colchester	37	1,643	1,700	21.76	5					4	
Collinsville	50	3,498	4,000	12.50	4		2			4	
Cuba	10	1,114	1,500	6.66						5	
Decatur	30	16,841	30,000	1	4		3		1	2	
Dwight	8	1,354	2,200	3.63	1		1				
East St. Louis	276	15,169	35,000	7.88	26		76	3		3	1
Elgin	262	17,823	22,000	11.90	13				1	16	
Eureka	19	1,481	1,700	11.17	1					1	
Fulton	32	2,099	3,000	10.66							
Galva	50	2,409	3,000	16.66	15						
Gilman	19	1,112	1,500	12.66	2		2			1	
Greenfield	20	1,131	1,200	16.66	4		4			15	
Griggsville	25	1,400	2,500	10	2		1		1	1	

a Two deaths from typhoid fever.

b One death from yellow fever.

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—						
					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Illinois—Continued.											
Harvard	38	1,967	4,500	8.44	3		4			2	1
Jacksonville	203	12,935	15,000	13.53	16		8		1	1	2
Kansas	40	1,037	1,200	33.33			1				
Kewanee	117	4,569	8,000	14.62	14		1			3	
Lena	26	1,270	1,500	17.33	8			2			
Leroy	9	1,258	1,600	5.62	1						
Maroa	9	1,164	1,500	6	2						
Mason	6	1,869	425	14.11	4						
Minouk	48	2,316	4,000	12	8					1	
Monmouth	96	5,936	10,000	9.60	12		2				
Monticello	28	1,643	2,200	12.72	2		3		1		
Morgan Park	11	1,027	2,500	4.40	2			1			
Morrison	19	2,088	2,500	7.60	1		1				
Mount Carroll	18	1,836	2,000	9			4			1	
Mount Pulaski	30	1,357	1,600	18.75	3						2
Nauvoo	21	1,208	1,300	15.38	2		3			1	
North Peoria	4	1,086	2,000	2							
Oregon	26	1,566	2,000	13	4						
Peoria	725	41,024	60,000	12.08	52		10		4	16	
Princeton	160	3,396	5,000	32						1	
Quincy	545	31,494	40,000	11.12	47		9		1	15	
Rantoul	8	1,074	1,400	5.71							
Red Budd	15	1,176	1,400	10.71	3		1				
Riverton	9	1,127	1,600	5.62	2		2			2	
Rock Falls	45	1,900	2,500	18	5		3			4	3
Rockford	335	23,584	35,000	9.28	41		10			51	1
Rushville	27	2,031	2,500	10.80							
Sandwich	32	2,516	2,700	11.85	5					1	
Savanna	33	3,097	4,000	8.25	2					1	
South Holland	9	1,005	1,100	8.18	3		1				
Springfield	482	24,963	31,093	15.82	75		15	2	1	7	1
Wheaton	25	1,632	2,500	10							
Total	26,756		2,066,944	12.94	2,621		632	155	97	892	173
Indiana:											
Angola	24	1,840	2,500	9.60	3		2				
Argos	20	1,101	1,400	14.28							
Aurora	29	3,929	4,000	7.25	5				1	2	
Batesville	18	1,169	2,000	9	1		1				
Bedford City	50	3,351	5,500	9.09							
Bluffton	30	3,589	5,000	6						5	
Bourbon	14	1,064	2,600	5.38	4		4	1	2	2	1
Bremen	14	1,076	1,600	8.75							
Brookville	25	2,028	2,000	12.50	3		1				
Brownstown	6	1,422	2,000	3							
Cannelton	30	1,991	3,000	10	5		5			1	
Columbia	15	3,027	3,500	4.28	4					1	
Columbus	118	6,719	8,550	13.18	25		4		1	5	2
Connersville	94	4,548	7,000	13.42	10		1				2
Danville	10	1,569	3,000	3.33			1				
Delphi	13	1,923	2,000	6.50	5				2		
Edinburg	15	2,031	2,000	7.50	2						
Elkhart	133	11,360	15,000	8.86	17		6	1	2	7	
Elwood	97	2,284	12,000	8.08	11		2		1	11	1
Evansville	827	50,756	67,000	12.34	125		28		2	9	
Fairmount	24	1,462	3,000	8	3		2	1			
Fort Wayne	598	35,393	48,500	12.32	57		19			23	
Fowler	3	1,285	2,000	1.50	2		1				
Frankfort	71	5,919	10,000	7.10	14		1			6	2
Franklin	51	3,781	4,800	10.62	9		1			2	
Garrett	40	2,767	3,000	13.33	5		1			5	
Goshen	129	6,038	10,000	12.90	15			3	20	24	18
Greencastle	44	4,390	4,390	10.02	2		3				
Hammond	154	5,428	16,000	9.62	22			1		24	
Huntington	120	7,328	10,000	12	33						
Indianapolis	2,112	105,436	195,000	10.83	325		54	6	12	34	
Jasper	16	1,281	1,800	8.88	2		1			1	1
Knightstown	22	1,867	2,200	10	3		1				
Laporte	56	7,126	8,000	7	7					6	
Lebanon	36	3,682	6,000	6	7		4	1		3	2

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—						
					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Indiana—Continued.											
Ligonier	13	2,195	3,000	4.33							
Madison	190	8,936	10,000	19	35		3			3	
Marion	375	8,769	20,000	18.75	50		15	3	2	18	5
Michigan	195	10,776	15,000	13	29		5	2	4	11	5
Mount Vernon	46	4,705	5,000	9.20	6			1	2	2	1
Muncie	275	11,345	26,000	10.57	30		13	2		10	1
Newcastle	33	2,697	3,500	9.42	2		2				
New Harmony	24	1,197	1,400	17.14	3		1	1		2	
Noblesville	50	3,054	6,000	8.33	4		2		2	1	1
North Manchester	8	2,384	3,000	2.66							
North Vernon	9	2,012	2,200	4.09	5						
Peru	99	7,028	9,635	10.27	3		9	1	3		
Plymouth	58	2,723	3,942	14.71	2		1			12	
Richmond	255	16,608	20,000	12.75	23		15	2		9	
Rising Sun	24	1,689	1,800	13.33	3		1				
Rochester	114	2,467	16,000	7.12	14		4				2
Salem	24	1,975	2,500	9.60	9		4		1	4	1
Shelbyville	85	5,451	7,500	11.33	13		3				
South Bend	261	21,819	30,600	8.52	32		5			10	
Spencer	15	1,868	5,000	3	3		1				
Sullivan	37	2,222	3,000	12.33	6		1				
Tell City	47	2,094	3,500	13.42	4		6	1			
Terre Haute	492	30,217	40,300	10.22	60		19	1	1	4	5
Tipton	43	2,697	4,000	10.75	8		9		1	4	1
Valparaiso	64	5,090	17,000	3.76	4		2	5	4	5	1
Vincennes	54	8,853	12,000	4.50	6		2			8	
Warsaw	26	3,574	5,000	5.20	4		2	1	1	1	
Williamsport	30	1,027	1,200	25	2					2	
Winamac	4	1,215	1,500	2.66	1						
Winchester	23	3,014	3,300	6.96	4		3			1	1
Total	8,031		759,217	10.58	1,091		271	34	64	279	53
Iowa:											
Albia	27	2,359	3,000	9			1				
Atlantic	30	4,351	5,000	6	2		3		1	1	
Audubon	14	1,310	1,800	7.77						4	
Bellevue	16	1,394	1,600	10	1		2				
Boone	89	6,520	9,000	9.88	13		5			1	
Brooklyn	12	1,202	1,200	10						5	
Burlington	357	22,565	28,000	12.75	27		3		5	4	7
Cedar Falls	59	3,459	6,000	9.83	7						1
Cedar Rapids	207	18,020	21,600	9.58	16					6	
Clarinda	52	3,262	3,200	16.25							
Clinton	222	13,619	25,000	8.87	26		2	1		5	1
Corning	16	1,682	2,000	8	1					1	
Council Bluffs	316	21,474	35,000	9.02	25		3	6		22	
Creston		7,200	7,800		1					3	
Davenport	568	26,872	35,000	16.22	41		6			5	6
Des Moines	648	50,093	76,000	8.52	57		11	3	1	20	6
Dubuque	466	30,311	45,000	10.35	41		7			27	5
Fairfield	34	3,391	4,500	7.55	3		1			2	
Fort Madison	25	7,901	10,000	2.50	3		2		1	3	
Harlan	18	1,765	2,700	6.66							
Ida Grove	17	1,563	2,000	8.50	1						
Keokuk	245	14,101	19,300	12.64	33		6			3	2
Knoxville	30	2,632	3,000	10						2	
Lansing	23	1,668	1,800	7.82	5						
Leon	12	1,422	2,000	6	2		2			2	
Lisbon	15	1,079	1,000	15							
Lucas	6	1,320	900	6.66			1				
Malvern	8	1,003	1,200	6.66				2		1	
Marion	75	3,094	5,000	15	14					6	3
Marshall	190	8,914	10,500	18.09	19		22	1	1	13	
Monticello	18	1,938	2,100	8.57							
Mount Ayr	12	1,256	1,600	7.50			2				
Mount Vernon	13	1,259	1,200	9.23	3						
Nevada	15	1,662	2,300	6.52			2			6	2
Osage	29	1,913	2,500	11.60							
Ottumwa	207	14,001	18,000	17.54	18		4		1	8	5
Perry	40	2,880	4,000	10	3		1		2		1

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

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					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Iowa—Continued.											
Rockford	13	1,010	1,200	10.83						1	2
Rock Rapids	7	1,394	2,000	3.50	1		1				
Sac City	12	1,249	1,550	7.74						5	
Sanborn	8	1,075	1,300	6.15							
Seymour	24	1,058	2,000	12	2		3				1
Sheldon	10	1,478	2,600	3.84			2				
Sibley	16	1,090	1,300	12.30							
Sioux City	252	37,806	39,735	6.34	22		6		1	11	
Traer	8	1,014	1,300	6.15			1				1
Waukon	9	1,610	1,850	4.86			3				
Washington	72	3,235	4,800	15	6		3	1	3	11	
Waverly	27	2,346	3,000	9	2		1				
Whatcheer	16	3,246	3,000	5.33	1		1			1	1
West Union	20	1,676	2,300	8.69							1
Total	1,871		211,285	8.86	152		39	8	10	65	13
Kansas:											
Alma	4	1,125	1,000	4			1		1		
Baxter Springs	20	1,248	4,000	5	6					1	
Beloit	30	2,455	2,600	8.66	7		3			1	8
Clay Center	186	2,802	15,700	11.21	20		5				4
Clyde	19	1,137	1,250	15.20						5	
Concordia	23	3,184	3,500	6.57	2		2			2	
Ellis	5	1,107	1,150	4.35	1					1	
Goodland	23	1,027	1,000	23	3				8		1
Great Bend	12	2,450	2,500	4.80	1						
Herington	15	1,353	1,500	10	2		1				
Hutchinson	91	8,682	8,500	10.70	7		11			5	1
Kingman	44	2,390	10,000	4.40	1		5	4			1
Larned	14	1,861	2,000	7	5		1				
Leavenworth	385	19,768	22,000	17.50	33		4		4	18	3
Lyons	16	1,754	1,500	10.66	2						
Medicine Lodge	8	1,095	800	10	1						
Minneapolis	67	1,756	11,000	6.09	9						
Neodesha	20	1,528	2,200	9.09							
Newton	60	5,605	6,500	9.07	4				1	4	3
Osawatomie	25	2,662	3,000	8.33	4		1				
Oswego	14	2,574	2,600	5.38	1		1			2	
Ottawa	38	6,248	8,000	4.75	13		1		1	21	2
Parsons	100	6,736	10,000	10	6		4	1	2	2	
Topeka	439	31,007	33,000	13.30	46		15	3	3	3	3
Washington	89	1,613	22,000	4.04	4		1		2	10	
Total	1,747		177,300	9.85	178		56	8	22	75	26
Kentucky:											
Barboursville	10	1,162	1,500	6.66	6					1	3
Bellview	70	3,163	7,000	10			2		1	3	1
Cloverport	22	1,527	1,800	12.22	2		3			1	
Covington	120	37,371	55,000	2.18	20		3	1	2	6	1
Cynthiana	62	3,016	4,000	15	11		2				
Elizabethtown	15	2,260	2,500	6							
Franklin	32	2,324	2,700	11.85	14		2				
Lawrenceburg	25	1,382	1,800	14.11	10		5				2
Louisville	3,105	161,129	215,572	14.87	441		93	4	4	53	
Madisonville	64	2,212	4,000	16	9		4	3		5	
Nicholasville	17	2,157	3,000	5.66	3						
Williamsburg	7	1,376	3,000	2.33	4					3	
Total	3,549		301,872	11.76	520		114	8	7	72	7
Louisiana:											
Amite	24	1,510	2,000	12						1	1
Baton Rouge	214	10,478	12,000	17.50	21		7	1			
Homer	11	1,132	1,500	7.33	3		1			1	
Mandeville	15	1,012	900	17.44	2						
Natchitoches	6	1,820	2,700	2.22	1		1				
New Orleans	6,730	242,039	275,000	24.40	859		141	1	1	47	2
Total	7,000		294,100	23.46	886		150	2	1	49	3

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

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Maine:											
Addison	12	1,022	1,000	12	2						
Appleton	25	1,080	1,000	25	2						
Athens	9	1,072	1,000	9	1				1		
Auburn	145	11,250	13,000	11.15	17		2			5	
Bangor	332	19,103	25,000	13.28			7			4	
Belgrade	28	1,090	1,000	28	4						
Berwick	33	2,294	2,300	14.34	5				1		
Blue Hill	37	1,980	2,000	18.50			3				
Boothbay	14	1,718	1,718	8.15			1				
Boothbay Harbor	43	1,699	1,699	25.31	3						
Bradford	24	1,215	1,200	20							
Bristol	37	2,821	3,000	12.33			1				
Brownville	20	1,074	1,200	16.66	4		1				
Buckfield	21	1,200	1,200	17.50						2	
Buxton	36	2,036	2,000	18						1	
Calais	140	7,290	8,000	17.50	12						
Canaan	22	1,130	1,126	19.53	2						
Canton	20	1,303	1,303	15.35							
Carmel	10	1,066	1,066	9.38	2						
Chelsea	18	2,356	1,000	18							
Clinton	17	1,518	1,518	11.13	1					2	
Corinna	16	1,207	1,200	13.33			1				
Cornish	13	1,118	1,100	11.82	1					1	
Cumberland	34	1,487	1,400	24.29	1		2				
Deering	117	5,353	7,000	16.71	7		2		1	3	
Deer Isle	64	3,422	2,200	29.09	7		1				
Dexter	70	2,732	2,700	25.92	4		2				
Dover	34	1,942	2,100	16.19	7						
East Livermore	35	1,506	2,000	17.50	2		2				
Eastport	66	4,908	5,000	13.20	22		1			1	
Eliot	25	1,463	1,450	17.24	2		1				
Ellsworth	90	4,804	5,000	18	6		5				
Falmouth	19	1,580	1,600	11.87							
Farmington	60	3,207	3,207	19.05	1		1				1
Franklin	7	1,264	1,260	5.71							
Frankfort	18	1,099	1,099	16.37	5						
Fort Fairfield	34	3,526	4,500	7.55							2
Freeport	61	2,482	2,500	24.40	4		2				
Fryeburg	18	1,418	1,400	12.85	3						
Gorham	7	2,888	4,000	1.75	8			3		1	
Gouldsboro	12	1,709	1,400	8.57							
Hancock	14	1,190	1,190	11.76	1		2				
Harrington	15	1,150	1,125	13.33	1		1				
Hermon	24	1,282	1,240	19.35	2						
Islesboro	11	1,006	1,006	10.93						2	
Jefferson	20	1,391	1,300	15.38							
Jonesport	26	1,917	2,000	13	6						
Limington	7	1,092	1,100	6.36							
Lincolnville	7	1,361	1,400	5	2					2	
Lisbon	51	3,120	3,500	14.57	1					4	
Litchfield	18	1,126	1,129	15.84							
Livermore	15	1,151	1,151	13.03							
Lubec	38	2,069	2,500	15.20	19						
Machiasport	13	1,437	1,437	9.04							
Millbridge	29	1,963	2,000	14.50	3						
Minot	10	1,355	800	12.50	2						
Monmouth	29	1,362	1,300	22.30	5						
Monroe	25	1,079	1,100	22.72							
Monticello	11	1,132	1,200	11	1						
New Gloucester	22	1,234	1,200	18.33	1						
Newport	24	1,188	1,500	16	7						
New Portland	16	1,034	1,000	16	3						
New Sharon	21	1,064	1,150	18.26							
Norridgewock	35	1,656	1,656	21.13	1		1				
Norway	34	2,665	3,000	11.33	4						
Oakland	30	2,044	2,000	15	3		3				
Oldtown	126	5,312	6,000	21	4					6	
Orland	31	1,390	1,400	22.13	2		2				
Palmyra	24	1,004	1,004	23.90	1					1	
Pembroke	26	1,514	1,514	17.11	1						
Penobscot	18	1,313	1,350	13.33	1			2			

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Maine—Continued.											
Phippsburg	22	1,396	1,400	15.71	5						
Pittston	4	1,281	800	5					1	3	
Portland	811	36,425	41,500	19.30	77		11	5	1	46	3
Presque Ile	41	3,046	4,000	10.25	7						
Randolph	16	1,281	1,281	12.58							
Readfield	10	1,176	1,200	8.33	1						
Saco	112	6,075	6,300	17.77	9		2				
St. Albans	24	1,206	1,206	19.90	1		1				
Sanford	83	4,201	6,000	13.88	6		2	1	1	2	1
Searsport	36	1,693	1,600	22.50	3						
Scarboro	26	1,794	2,000	13	1				3		
Sedgwick	20	1,012	1,000	20				1	2	3	
Sidney	24	1,334	1,200	20							
South Berwick	77	3,434	3,434	21	4					1	1
Stockton Springs	10	1,149	1,000	10	2						
Thomaston	28	3,009	3,000	9.33	3		1			1	
Waldoboro	72	3,505	3,500	20.59			8			1	
Washburn	17	1,097	1,200	14.16							
Washington	23	1,230	1,231	18.68	1					1	
Waterville	183	7,107	8,000	23	26		5				
Westbrook	118	6,632	6,500	18.15	3		2	3		2	
Whitefield	21	1,215	1,200	17.50	2						
Wilton	20	1,622	1,600	12.50	5						
Windham	39	2,216	2,250	17.77				2			
Yarmouth	49	2,098	2,200	22.22	1			1			
Total	4,399		278,300	15.81	358		71	18	11	95	8
Maryland:											
Baltimore	9,329	434,439	506,398	18.43	1,047		189	16	53	360	42
Easton	9	2,939	5,000	1.80	3		3			3	
Frederick	159	8,193	10,000	15.90	13		1		1	2	1
Frostburg	80	3,804	6,000	13.33	2						
Havre de Grace	42	3,244	3,500	12	4		3			2	
Northeast	6	1,249	1,300	4.61	1		1			1	
Salisbury	28	2,905	1,300	21,57							
Snow Hill	7	1,483	1,500	4.66	3						
Total	9,660		534,998	18.51	1,073		197	16	54	368	43
Massachusetts:											
Acushnet	31	1,027	1,135	27.33	1		1	1		1	
Adams	179	9,213	10,000	17.90	16		4		1	4	
Agawam	38	2,352	2,425	15.67	6					2	
Amesbury	176	9,798	10,000	17.60			2				1
Amherst	88	4,512	5,000	17.60	2						
Arlington	141	5,629	7,000	20.13	17		1	1		2	
Ashburnham	24	2,074	2,000	12							
Ashfield	13	1,025	1,025	12.69	1						
Ashland	26	2,532	2,090	12.44	3						
Auburn	26	1,532	1,600	16.25	1						
Avon	30	1,384	1,640	18.29						1	1
Ayer	41	2,148	2,100	19.52	4		2				
Barnstable	63	4,023	4,055	15.54	7				1	1	1
Barre	46	2,239	2,278	20.19	3				1	1	
Belchertown	44	2,120	2,161	20.32	5						
Belmont	50	2,098	3,500	14.28						1	
Beverly	168	10,821	13,000	12.92	14		4	1		11	
Billerica	42	2,380	2,630	15.97	4					1	
Boston	11,154	448,477	528,912	21.09	1,289		173	21	136	456	39
Braintree	110	4,848	5,300	20.75	7		1	1	2	3	
Brewster	18	1,003	901	19.79	1					1	
Bridgewater	51	4,249	4,700	10.85	5						
Brimfield	21	1,096	962	21.03							
Brockton	473	27,294	35,853	13.19	60		4	2	4	22	3
Brookfield	58	3,352	3,200	18.13	7						
Brookline	203	12,103	17,500	11.60	21		2			6	
Buckland	24	1,570	1,900	12.63	3			1			
Cambridge	1,531	70,028	86,812	17.63	197	2	11	3	10	51	17
Chatham	43	1,954	1,805	23.83	3		1		2		
Chelsea	593	27,909	33,000	17.97	87		6	1	1	13	7

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Massachusetts—Cont'd.											
Chester	24	1,295	1,400	17.14	1	....	....	....	....	1	....
Chelmsford	63	2,695	3,200	20	3	....	....	....	....	4	....
Chicopee	361	14,050	18,500	19.51	33	....	5	1	....	21	2
Clinton	161	10,424	13,000	12.38	24	....	....	....	1	2	....
Concord	49	4,427	5,525	8.68	3	....	1	....	1	1	....
Conway	16	1,451	1,400	11.42	....	....	....	....	....	....	....
Cottage City	15	1,080	1,050	14.29	1	....	....	1	....	....	....
Dalton	52	2,885	3,210	16.20	....	....	2	....	1	1	....
Danvers	112	7,454	7,500	14.94	10	....	2	....	1	3	....
Dartmouth	74	3,122	3,100	23.87	1	....	1	....	1	....	....
Dedham	122	7,123	6,500	18.77	18	....	....	....	....	4	....
Deerfield	42	2,910	3,000	14	5	1	1	....	....	....	....
Dennis	50	2,899	2,545	19.84	4	....	1	....	....	....	....
Dighton	31	1,889	1,800	17.33	5	....	....	....	....	....	....
Douglass	57	1,908	2,000	28.50	9	....	....	....	....	2	....
Dracut	46	1,996	2,500	18.40	....	....	....	....	....	....	....
Dudley	58	2,944	3,203	18.11	1	....	....	....	....	4	....
Easthampton	60	4,395	5,000	12	6	....	....	....	....	1	....
Edgartown	18	1,156	1,200	15	....	....	1	....	....	....	....
Essex	32	1,713	1,587	20.16	....	....	....	1	....	2	....
Everett	363	11,068	22,000	16.50	35	....	4	2	5	25	8
Fall River	2,135	74,398	101,103	21.12	168	....	32	9	32	29	11
Falmouth	55	2,567	2,655	20.72	12	....	....	....	....	1	....
Fitchburg	414	22,037	28,392	14.58	35	....	5	1	....	13	1
Foxboro	67	2,933	3,500	19.14	....	....	....	....	....	1	....
Framingham	158	9,239	10,000	15.80	14	....	2	1	....	12	1
Franklin	66	4,831	5,700	11.56	6	....	1	....	....	....	....
Freetown	27	1,417	1,400	19.29	1	....	....	....	....	....	....
Gardner	142	8,424	10,000	14.20	16	....	2	....	1	6	....
Grafton	84	5,002	5,000	16.80	4	....	1	....	....	1	....
Granville	32	1,061	1,004	31.87	2	....	....	....	....	....	....
Great Barrington	66	4,612	5,000	13.20	2	....	2	....	....	....	....
Greenfield	115	5,252	7,500	15.33	7	....	2	....	2	2	....
Groton	37	2,057	2,200	16.82	5	....	1	....	....	....	....
Groveland	38	2,191	2,333	16.25	....	....	3	....	2	....	....
Hadley	32	1,669	1,704	18.78	3	....	....	1	....	....	....
Hanson	20	1,267	1,300	15.38	1	....	1	....	....	....	....
Hardwick	36	2,922	3,000	12	1	....	....	....	....	2	....
Harward	24	1,095	1,200	20	....	....	....	....	....	....	....
Harwich	48	2,734	2,534	18.94	....	....	....	....	....	....	....
Hatfield	22	1.246	1,300	16.92	....	....	....	....	....	....	....
Haverhill	517	27,412	36,631	14.11	79	....	16	1	5	20	1
Hingham	78	4,564	4,564	17.09	7	....	....	....	1	7	....
Hinsdale	23	1,739	1,500	15.33	2	....	....	....	1	....	....
Holden	35	2,623	2,602	13.41	....	....	....	....	....	....	....
Holliston	43	2,619	2,700	15.92	5	....	....	....	....	....	....
Holyoke	827	35,637	44,214	18.70	47	....	3	6	2	2	2
Hopedale	9	1,176	1,451	6.20	....	....	1	....	....	....	....
Hopkinton	42	4,088	4,000	10.50	....	....	....	....	....	....	....
Hydepark	204	10,193	13,000	15.69	22	....	2	1	1	7	1
Ipswich	81	4,439	4,720	17.16	....	....	1	....	....	6	....
Kingston	33	1,659	1,650	20	3	....	....	....	....	....	....
Lancaster	39	2,201	2,180	17.89	2	....	....	....	....	....	....
Lanesboro	23	1,018	848	27.12	....	....	1	....	....	....	....
Lawrence	1,087	44,654	55,510	19.58	20	....	9	....	11	31	1
Lee	58	3,785	4,066	14.26	5	....	....	....	....	....	....
Leicester	51	3,120	3,200	15.62	6	....	2	....	....	....	....
Leominster	145	7,269	10,000	14.50	18	....	2	....	....	....	....
Lexington	53	3,197	3,498	15.15	....	....	1	....	....	....	....
Ludlow	47	1,939	2,562	18.34	....	....	....	....	....	1	....
Lunenburg	17	1,146	1,300	13.07	2	....	2	....	....	....	....
Malden	463	28,031	32,500	14.24	53	....	4	1	1	16	....
Manchester	24	1,789	1,900	12.63	6	....	....	....	....	....	....
Maynard	49	2,700	3,090	15.85	2	....	....	....	....	1	....
Medfield	24	1,493	1,900	12.63	2	....	....	....	....	....	1
Medford	216	11,079	15,832	13.63	13	....	1	2	....	....	1
Melrose	180	8,519	12,520	14.37	19	....	2	3	....	4	2
Merrimac	30	2,633	2,300	13.04	2	....	....	....	2	1	....
Methuen	93	4,814	6.500	14.31	11	....	3	....	....	3	....
Middleboro	88	6,065	6,689	13.30	4	....	1	....	....	1	....
Milford	174	8,780	8,959	19.42	25	....	3	....	1	1	....

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Massachusetts—Cont'd											
Milton	84	4,278	5,700	14.74	15			1	1	1	
Monson	60	3,650	3,900	15.39	7		1				
Nantucket	72	3,268	3,000	24	4						
Needham	54	3,035	3,500	15.43	4		2			3	
New Bedford	1,275	40,733	56,000	22.77	91		23	5	13	47	1
Newbury	16	1,427	1,500	10.66	1						
Newburyport	232	13,947	14,552	15.94	17		8			9	
Newton	447	24,379	28,000	15.96	43		5		5	12	
North Adams	333	16,074	22,000	15.15	28		9		1	18	2
Northampton	322	14,990	17,000	18.94	33		3		1	21	
North Andover	61	3,742	3,569	17.09	3		1			1	
North Attleboro	78	6,727	6,720	11.61	9		2			1	
Northfield	31	1,869	1,850	16.76	2		2			2	
Norwell	27	1,635	1,634	16.52	1						
Orange	75	4,568	5,000	15	10		1				
Orleans	24	1,219	1,200	20							
Oxford	56	2,616	2,400	23.33	5		2				
Peabody	207	10,158	11,000	18.82	25	1	4	1		18	1
Palmer	114	6,520	6,858	16.62	13		1			4	
Petersham	24	1,050	912	26.33	6		2				
Pittsfield	294	17,281	22,000	13.36	25		3			7	
Plymouth	152	7,314	8,000	16.25	15				1	3	3
Provincetown	79	4,642	4,650	16.99	4		1				1
Quincy	354	16,723	22,562	15.69	41		6	3	2	3	
Reading	62	4,088	5,000	12.40	6		1			3	
Rehoboth	35	1,786	1,800	19.44	4		2				
Rochester	15	1,012	1,012	14.82	2		2				
Rockland	84	5,213	5,650	14.81	8						2
Rockport	77	4,087	4,500	17.10	11				2	2	
Rowley	17	1,248	1,275	13.33	2		1			1	
Royalston	25	1,030	890	25.85							
Salem	594	30,801	36,000	16.50	47		6		4	15	
Sandwich	24	1,819	1,600	15	1						
Scituate	53	2,318	2,300	23.04	8		3			2	
Sharon	34	1,634	1,717	18.97						1	
Sheffield	30	1,954	1,887	15.95			1				
Sherborn	29	1,381	1,446	20.06							
Shirley	29	1,191	1,400	20.71	1						
Somerset	41	2,106	2,000	20.50	1		1			1	
Somerville	859	40,152	58,000	14.81	67	1	11	3	6	44	4
Southampton	14	1,017	1,054	13.28	2						
Southboro	42	2,114	2,100	20	12					1	
Southbridge	159	7,655	8,000	17.37	15		2			6	
South Hadley	68	4,261	4,443	15.30	5					2	
Stockbridge	30	2,132	2,077	14.43	2						
Stoneham	96	6,155	6,300	15.24	16		1				
Stoughton	89	4,852	5,272	16.88	11					4	
Sturbridge	41	2,074	2,000	20.50	2		1			5	2
Sudbury	23	1,197	1,150	20	1						
Sutton	64	3,180	3,480	18.39	5					2	
Swampscott	54	3,198	3,500	15.43						1	
Swansea	18	1,456	1,650	10.91	3					1	
Taunton	588	25,448	27,812	21.14	59		6	2	4	10	1
Templeton	54	2,999	3,000	18					1		
Tisbury	15	1,506	1,000	15							
Topsfield	27	1,022	1,027	26.29							
Townsend	42	1,750	1,700	24.70	2						
Upton	37	1,878	2,150	17.21	5		1		2	1	
Uxbridge	72	3,408	3,550	20.28	3					1	
Walpole	47	2,604	3,000	15.66	3					2	
Waltham	288	18,707	21,500	13.39	31		2		2	6	
Ware	132	7,329	7,651	17.20	9			2		3	
Warren	62	4,681	4,000	15.50	10					1	
Watertown	103	7,073	8,060	12.78	12		1	2	8	5	
Wayland	29	2,060	2,500	11.60						1	
Wellesley	47	3,600	5,000	9.40	3					1	
Wellfleet	20	1,291	960	20.83							
West Boylston	44	3,019	3,000	14.66						1	
West Bridgewater	20	1,917	1,747	11.45	2						
Westfield	154	9,805	10,663	14.44	19		4			2	
Westford	41	2,250	2,418	16.96				1			

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

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					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Massachusetts—Cont'd.											
Westminster	26	1,688	1,300	20	4	......	......	......	....	......	....
West Newbury	23	1,796	1,700	13.53	6	......	2	......	....	......	....
Weston	20	1,664	1,710	11.69	2	......	......	......	....	......	....
Westport	37	2,599	2,678	13.83	2	......	1	3	....	......	....
West Stockbridge	22	1,492	1,257	17.50	......	......	......	......	....	......	....
Weymouth	195	10,866	11,400	17.10	19	......	3	1	4	4	1
Whitman	78	4,441	6,000	13	13	......	......	......	....	......	....
Williamsburg	42	2,057	2,000	21	11	......	......	1	....	......	1
Wilmington	25	1,213	1,400	17.86	3	......	1	......	....	1	....
Winchester	76	4,861	6,500	11.69	11	......	1	......	3	5	....
Woburn	251	13,499	14,178	17.70	35	......	3	3	....	5	2
Worcester	1,791	84,655	106,202	16.86	228	......	15	17	8	59	1
Yarmouth	39	1,760	1,650	23.64	2	......	......	......	....	......	....
Total	37,296	....	2,072,638	17.99	3,478	5	483	108	928	1,165	123
Michigan:											
Albion	60	3,763	5,000	12	3	......	1	......	....	......	....
Allegan	29	2,669	2,800	10.36	......	......	......	1	....	1	....
Ann Arbor	115	9,431	14,000	8.21	8	......	1	......	....	......	....
Battlecreek	81	13,197	18,000	4.50	......	......	......	......	....	......	....
Bay City	317	27,839	33,000	9.60	25	......	12	......	....	2	....
Benton Harbor	66	3,692	7,000	9.43	2	......		......	....	3	....
Bessemer	46	2,566	3,500	13.14	4	......	......	......	....	11	1
Big Rapids	57	5,303	6,000	9.50	7	......	1	......	....	......	....
Blissfield	20	1,132	2,100	9.52	2	......	1	......	....	2	....
Buchanan	34	1,994	2,000	17	1	......	1	......	....	1	....
Cadillac	44	4,461	5,500	8	3	......	......	......	....	......	....
Caro	15	1,701	2,000	7.50	5	......	1	1	....	2	....
Carrollton	7	1,074	750	9.33	1	......	......	......	....	......	....
Cassopolis	9	1,369	1,450	6.21	2	......	......	......	....	......	1
Charlevoix	30	1,496	2,500	12	3	......	2	......	....	......	....
Cheboygan	108	6,235	7,000	15.42	8	......	......	1	....	2	2
Chelsea	22	1,356	1,500	14.66	2	......	......	1	....	......	....
Chesaning	14	1,056	1,300	10.70	......	......	......	......	....	......	....
Clare	7	1,174	1,500	4.66	......	......	......	......	....	......	....
Coldwater	82	5,247	5,286	15.51	7	......	1	1	....	2	....
Constantine	27	1,346	2,500	10.80	4	......	......	......	....	......	....
Decatur	15	1,109	1,300	11.53	......	......	......	......	....	......	....
Detroit	4,848	205,876	275,000	17.63	249	......	38	16	53	225	7
Dowagiac	27	2,806	4,000	6.75	4	......	......	......	....	......	....
Eastlake	26	1,856	3,000	8.66	9	......	1	......	....	......	....
Escanaba	55	6,808	8,000	6.88	6	......	3	......	....	2	....
Flint	117	9,803	10,420	11.23	12	......	1	1	....	1	1
Gladstone	10	1,337	3,000	3.33	2	......	1	......	....	......	....
Harbor Springs	12	1,052	1,200	10	2	......	2	1	....	......	....
Hillsdale	56	3,915	4,400	12.73	2	......	......	1	....	......	....
Holland	60	3,945	8,000	7.50	6	......	4	......	....	1	....
Holly	2	1,266	1,800	1.11	1	......	1	......	....	......	....
Homer	9	1,063	1,200	7.50	1	......	......	......	....	......	....
Howard	10	1,137	1,650	6.07	......	......	......	......	....	......	....
Imlay	8	1,251	1,300	6.15	......	......	......	......	....	......	....
Ionia	50	4,482	5,000	10	......	......	......	......	1	......	....
Iron Mountain	110	8,599	8,000	13.75	7	......	1	......	....	1	....
Iron River	5	1,117	800	6.25	......	......	......	......	1	......	....
Ironwood	90	7,745	9,000	10	10	......	1	......	1	5	2
Ishpeming	141	11,197	12,000	11.75	14	......	4	1	....	11	4
Ithaca	16	1,627	2,400	6.66	......	......	1	......	....	......	....
Jonesville	22	1,288	1,500	14.67	3	......	......	......	....	......	....
Kalamazoo	248	17,853	22,000	11.27	30	......	7	......	....	6	2
Lake Linden	34	1,862	2,400	14.17	......	......	......	......	....	......	....
Lakeview	7	1,024	1,200	5.83	1	......	......	......	....	......	....
Lapoer	23	2,753	3,500	6.57	2	......	2	......	1	2	....
Mancelona	13	1,205	1,400	9.29	1	......	......	......	....	......	....
Manistee	250	12,812	15,000	16.66	25	......	3	......	....	1	2
Manistique	30	2,940	3,000	10	4	......	......	......	....	......	....
Marine	38	3,268	3,500	10.83	2	......	1	......	....	1	....
Mason	25	1,875	1,800	13.89	3	......	......	......	....	......	....
Mount Clemens	108	4,748	6,000	18	4	......	1	......	3	1	....
Mount Pleasant	24	2,701	3,500	6.85	2	......	......	......	....	1	....
Muskegon	437	22,702	23,000	19	......	......	......	......	....	......	....

TABLE OF ANNUAL MORTALITY STATISTICS IN 1.597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

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					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Michigan—Continued.											
North Muskegon	1	1,590	350	2.86	......	......	1	......	....	......	....
Oscoda	10	3,593	1,500	6.66	2	......	......	......	....	......	....
Otsego	21	1,626	1,700	12.41	1	......	......	......	....	1	....
Owosso	122	6,564	11,000	11.09	......	......	......	......	....	9	....
Paw Paw	28	1,391	2,400	11.66	4	......	......	......	....	......	....
Pentwater	18	1,510	1,400	12.86	......	......	1	......	....	8	....
Petosky	35	2,872	4,500	7.77	2	......	2	......	2	......	....
Pontiac	125	6,200	7,500	16.66	3	......	......	......	....	......	....
Port Huron	249	13,543	20,000	12.45	8	......	1	......	4	7	1
Richmond	16	1,074	1,300	12.31	2	......	1	......	....	......	....
St. Ignace	25	2,704	2,500	10	4	......	......	......	....	......	....
St. Louis	33	2,246	2,200	15	6	......	2	......	....	......	....
Sand Beach	8	1,046	1,250	6.40	......	......	......	......	....	......	....
Sault Ste Marie	116	5,760	10,000	11.60	3	......	1	......	....	......	....
South Haven	12	1,924	4,000	3	......	......	1	......	....	......	1
Stanton	18	1,352	1,303	13.83	1	......	......	......	....	......	1
Sturgis	20	2,489	3,300	6.06	......	......	......	......	....	......	....
Tawas	15	1,544	1,200	12.50	4	......	......	......	....	......	....
Three Rivers	28	3,131	4,000	7	2	......	......	2	....	1	....
Traverse	49	4,353	8,500	5.82	7	......	1	......	....	4	1
Union	14	1,156	1,585	8.83	1	......	......	......	....	3	....
Vassar	25	1,682	2,000	12.50	1	......	1	......	....	......	....
Wyandotte	40	1,817	4,500	8.88	......	......	4	......	....	13	....
Total	8,944	....	671,944	13.31	540	......	109	28	66	330	26
Minnesota:											
Albert Lea	48	3,305	5,000	9.60	5	......	1	......	....	1	....
Alexandria	14	2,118	2,600	5.39	1	......	......	......	....	......	....
Blue Earth	29	1,569	3,000	9.66	4	......	......	......	....	......	....
Cannon Falls	16	1,078	1,500	10.66	......	......	1	......	....	......	....
Cloquet	9	2,530	3,000	3	1	......	......	......	....	......	....
Crystal	3	1,074	1,000	3	......	......	......	......	....	......	....
Detroit	17	1,510	2,000	8.50	3	......	......	......	....	......	....
Fairmont	21	1,205	2,300	9.13	6	......	1	......	....	......	....
Faribault	114	6,520	10,000	11.40	4	......	4	......	....	17	....
Hastings	24	3,705	4,000	6	......	......	......	......	....	......	....
Jordan	19	1,233	1,500	12.66	......	......	......	......	....	1	....
Lake City	27	2,128	3,000	9	6	......	......	......	....	......	....
Lesueur	17	1,763	2,200	7.73	4	......	......	......	....	......	....
Littlefalls	59	2,354	5,500	10.73	6	......	3	......	....	1	....
Mankato	84	8,838	12,000	7	12	......	2	......	....	1	....
Minneapolis	1,971	164,738	225,602	8.74	234	......	148	......	7	28	14
Montgomery	6	1,086	1,100	5.45	1	......	......	......	....	......	....
Montevideo	18	1,437	2,000	9	2	......	2	......	....	......	....
Morris	13	1,266	1,800	7.22	1	......	......	......	....	1	....
North St. Paul	10	1,099	1,000	10	1	......	......	......	....	1	....
Owatonna	33	3,849	6,500	5.07	2	......	......	......	....	2	....
Red Wing	84	6,294	8,000	10.50	14	......	......	......	....	2	....
St. Charles	18	1,178	1,500	12	1	......	......	......	....	......	....
St. Paul	1,387	133,156	215,582	6.43	203	......	22	13	11	46	5
St. Paul Park	10	1,173	800	12.50	......	......	......	......	....	......	....
St. Peter *a*	25	3,671	3,500	7.14	4	......	......	......	....	......	....
Sauk Center	17	1,695	2,500	6.80	6	......	......	......	....	......	....
Sauk Rapids	7	1,185	1,400	5	......	......	......	......	....	......	....
Shakopee	14	1,757	2,000	7	2	......	1	......	....	......	....
Sleepyeye	13	1,513	2,000	6.50	3	......	......	......	....	......	....
South St. Paul	13	2,242	2,100	6.19	2	......	......	......	....	3	....
South Stillwater	12	1,304	1,240	9.68	3	......	1	......	....	......	....
Spring Valley	36	1,381	2,060	17.33	4	......	......	......	....	1	1
Tracy	3	1,400	2,000	1.50	1	......	......	......	....	......	....
Wabasha	30	2,487	3,000	10	2	......	......	......	....	1	....
Willmar	26	1,825	3,000	8.66	3	......	......	......	....	......	....
Winona	250	18,208	22,000	11.36	22	......	......	4	....	1	2
Worthington	15	1,164	2,000	7.50	......	......	1	......	....	......	....
Total	4,514	....	572,284	8.02	563	......	187	17	18	107	22

a St. Peter State Hospital for Insane, 82.

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—						
					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Mississippi:											
Bay St. Louis	75	1,974	2,500	30	7		7				
Biloxi	120	3,234	5,000	24							
Gloster	2	1,142	1,300	1.54						1	
Grenada	40	2,416	3,000	13.33	1						
Greenwood	20	1,055	2,000	10	3		3			1	
Hattiesburg	10	1,172	3,000	3.33							
Iuka	14	1,019	1,000	14	2						
Lexington	4	1,075	1,200	3.33	1						
Ocean Springs *a*	14	1,148	1,500		2						
Okolona	22	2,099	2,200	10						1	
Oxford	24	1,546	2,500	9.60	5					2	
Summit	10	1,587	2,500	4	2		2			1	1
Tupelo	12	1,477	1,800	6.66	1						
Total	367		29,500	12.44							
Missouri:											
Albany		1,334	2,500								
Appleton	15	1,081	1,800	8.33	6		2			1	
Aurora		3,482	5,000								
Cape Girardeau	73	4,297	5,000	14.60	11		3	2		2	
Charleston		1,381	2,000		2		1	2			
Clarksville	25	1,186	1,500	16.66							3
Clinton	64	4,737	7,000	9.14	7		3			4	
Crystal	9	1,104	1,500	6	1						
Eldorado Springs	50	1,543	3,000	16.66	3		15				
Grant	10	1,186	1,800	5.55			1			2	
Hannibal *b*	154	12,857	15,000	10.27	6		9			5	
Kirkwood	21	1,777	2,500	8.40	3						
Lebanon	45	2,218	3,000	15	7			1		5	
Milan	19	1,234	2,000	9.50	3		1				
Monroe	18	1,830	2,500	7.20	4						1
Mound	60	1,193	1,860	32.26	1		5			12	10
Palmyra	30	2,515	3,000	10	4		2			5	
Poplarbluff	90	2,187	6,000	15	22		4	2		3	
St. Joseph	682	52,324	55,000	12.40	66		22	6	4	21	15
St. Louis	9,550	451,770	600,000	15.91	997	3	125	1	19	250	57
Seneca	10	1,101	1,200	8.33						2	
Springfield	455	21,850	3,500	130	114					3	
Stanberry *c*	75	2,035	5,000	15	16		4		1	10	
Unionville	6	1,118	1,800	3.33	1					3	
Washington	30	2,725	3,000	10	2		2				
Wellsville	30	1,138	2,500	12	1		2			2	
Willowsprings	15	1,535	1,800	8.33	1					3	
Total	11,536		740,760	15.57	1,278	3	201	14	24	333	86
Montana:											
Bozeman	34	2,143	4,000	8.50	3		2				
Butte	471	10,723	47,000	10	30		18	1		17	2
Dillon	18	1,012	1,800	10			3			6	
Greatfalls	105	3,979	12,000	8.75	5		7	1		2	5
Marysville	12	1,489	1,500	8	1		2				
Total	640		66,300	9.65	39		32	2		26	7
Nebraska:											
Beatrice	102	13,836	12,000	8.50			4	1		11	1
Blair	23	2,069	3,000	7.66	3		1	1		4	
Central	23	1,368	1,800	12.66	1					3	
Crete	30	2,310	3,000	10	5					2	
Fairmont	10	1,029	800	12.50							
Grand Island	60	7,536	8,000	7.50	3		5				2
Lincoln	283	55,154	50,000	5.66	1		14	6		3	2
Norfolk	42	3,038	5,000	8.40	4		1	1		1	
North Platte	34	3,055	3,500	9.71	4		1				
Omaha	960	140,452	140,000	6.86	108				9	39	
Pawnee	17	1,550	2,000	8.50	1		5				

a Twelve deaths from yellow fever.
b Two deaths from typhus.
c Seven deaths from typhus.

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Nebraska—Continued.											
South Omaha	204	8,062	15,000	13.60							
Sutton	12	1,541	1,850	6.49	2		1				4
Tecumseh	10	1,654	2,750	3.63	1		1			1	
Tekamah	6	1,244	1,600	3.75	1						
Total	1,816		250,600	7.25	134		33	9	9	64	9
Nevada:											
Reno	63	3,563	5,000	12.60	10				1	3	
Tuscarora	10	1,156	850	11.76					1		
Virginia City	79	8,511	5,000	15.80	13		2		1	6	
Total	152		10,850	14.01	23		2		3	9	
New Hampshire:											
Alton	21	1,372	1,375	15.35					2		
Amherst	13	1,053	1,000	13	1						
Barnstead	19	1,264	1,250	15.20							
Barrington	26	1,408	1,400	18.57	3		1			1	
Bedford	26	1,102	1,100	23.63			1			1	
Belmont	23	1,142	1,100	20.99							
Bethlehem	32	1,267	1,250	25.62	4						
Bristol	27	1,524	1,500	11.33	2						
Canaan	28	1,417	1,472	19.02	2		1				
Candia	21	1,108	1,108	18.95	2		2				
Charlestown	28	1,466	1,560	17.95	3					1	
Chesterfield	12	1,046	1,200	10							
Claremont	106	5,565	6,500	16.31						8	
Concord	349	17,004	18,000	19.39	5		2		1	1	
Epping	37	1,721	1,700	21.76	4		1			1	
Farmington	63	3,064	3,064	20.56	14		1				
Franklin	66	4,085	4,500	14.67	2						
Goffstown	32	1,981	2,000	16	8					1	
Hanover	31	1,817	1,800	17.17	1						
Haverhill	62	2,545	2,545	24.36	10					3	
Henniker	16	1,385	1,300	12.31	1					1	
Hillsboro	48	2,120	2,400	20							
Hinsdale	30	2,258	2,000	15	2						
Hopkinton	27	1,817	1,800	15	1		2				
Hudson	22	1,092	1,100	20	3					1	
Keene	139	7,446	8,000	17.38	11		1			1	
Lisbon	44	2,060	2,200	20	3						
Londonderry	32	1,220	1,200	26.66	1		1				
Manchester	1,018	44,126	60,000	16.97	88		12	3	1	37	13
Marlboro	22	1,695	1,600	13.75	1						
Milan	17	1,029	1,200	14.17							
Milford	58	3,014	4,000	14.50	4		1	1			
Milton	26	1,640	2,000	13	3						
Moultonboro	18	1,034	1,000	18	2						
Newmarket	57	2.742	3,000	19	9					1	
Northumberland	27	1,356	2,000	13.50	2		1				
Ossipee	32	1,630	1,700	18.82	4				2	1	
Peterboro	48	2,507	2,500	19.20	3					2	
Pittsfield	31	2,605	2,300	13.48	3						
Plaistow	13	1,085	1,200	10.83							
Raymond	16	1,131	1,130	14.16	2				1		
Salem	31	1,805	1,900	16.32	2						
Sanbornton	16	1,027	1,000	16	2					2	
Somersworth	159	6,207	6,500	24.46	5		5			6	
Swanzey	19	1,600	1,600	11.88	3						
Tilton	33	1,521	1,900	17.37	1						
Wakefield	30	1,528	1,700	17.65							
Walpole	60	2,163	2,100	28.57	4			1			
Warner	28	1,383	1,400	20	4					4	
Weare	25	1,550	1,500	16.67	2						
Winchester	42	2,584	2,800	15	7		1				
Wolfsboro	43	3,020	3,030	14.19			1		1	1	
Total	3,249		184,182	17.64	234		34	5	8	74	13

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—						
					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
New Jersey:											
Atlantic City	241	13,055	24,500	9.84	11		4		1	5	1
Boundbrook	20	1,462	2,500	8	2					5	
Carlstadt	33	1,549	3,000	11	2						
Clayton	23	1,807	2,000	11.50	3						
Dunellen	11	1,060	1,300	8.46	4					3	
Egg Harbor	27	1,439	1,537	17.57	1					2	1
Fort Lee	63	1,253	1,253	50.27	1		1			1	
Frenchtown	13	1,023	1,052	12.34	2						1
Hackettstown	30	2,417	2,500	12	1						
Haddonfield	49	2,502	2,600	18.85	6		3		1	7	1
Hammonton	96	3,833	3,850	24.94				1		3	2
Hoboken	1,078	43,648	57,000	18.91	129		8		13	30	5
Jersey City	3,634	163,003	191,481	18.98	438		41	8	39	185	13
Lambertville	102	4,142	4,620	22.08	4		12			1	
New Brunswick	282	18,603	20,432	13.80	45		7		1	12	5
Ocean Grove	45	2,754	2,000	22.50	3		2				
Orange	380	18,844	24,000	15.83			2		4	20	
Oxford	24	2,383	2,500	9.50	2		2				
Raritan	45	2,665	2,694	16.74	2		1			1	
Riverton	9	1,075	1,250	7.20							
Salem	127	5,516	6,337	20.04							
South Amboy	108	4,330	7,000	15.43	2					8	3
South Orange	27	3,106	4,500	6	3						
Tenafly	12	1,046	1,800	6.67	2						
Toms River	24	1,147	2,800	8.57							
Union	28	10,643	3,500	8							
Woodbury	64	3,911	4,000	16	6					1	
Total	6,595		382,006	17.26	669		83	9	59	284	32
New Mexico:											
Deming	8	1,136	1,600	5	1	1					
Las Vegas	35	2,385	3,000	11.66	24		2	1	1		
Total	43		4,600	9.35	25	1	2	1	1		
New York:											
Adams	21	1,360	1,279	16.42							
Addison	39	2,166	2,600	15	4		3				
Albany	2,016	94,923	98,000	20.37	259		84		2	69	
Albion	103	4,586	7,000	14.71	10		3			3	
Alexandria Bay	14	1,123	1,300	10.77	4						
Amityville	18	2,293	1,700	10.59	2						
Attica	39	1,994	2,800	13.93							
Avon	35	1,653	2,000	17.50	6						
Baldwinsville	42	3,040	3,040	13.81	6						
Ballston Spa	62	3,527	4,153	14.93	3		1			2	1
Bainbridge	36	1,049	2,400	15							
Bath on Hudson	48	2,399	2,448	19.61	11		1			4	
Binghamton	590	35,005	44,000	13.41	62		13	14	1	14	7
Boonville	55	1,613	4,000	13.75	10						
Brockport	74	3,742	3,725	19.87	7				2		
Brooklyn	20,674	806,343	1,160,000	17.82	2,164	3	173	190	187	998	164
Buffalo	4,475	255,664	360,000	12.43	425		63	38	21	198	71
Cambridge	28	1,598	1,600	17.50	3		2				
Canajoharie	60	2,089	4,300	13.95	5						
Canton	98	2,580	6,195	15.82	40	1			1		
Cape Vincent	25	1,324	1,308	19.11	1		1				
Castile	25	1,146	2,400	10.42	7		1				
Catskill	74	4,920	5,365	13.05	3					2	
City Island	12	1,206	1,388	8.65	1					1	
Clifton Springs	32	1,297	1,537	20.85	2					1	
Clinton	17	1,269	1,100	15.45	3		2				
Cobleskill	53	1,822	3,436	15.42	6		3			1	
Cohoes	474	22,509	26,000	18.23	59		14			48	
Cooperstown	35	2,657	2,358	14.80	7					1	
Corning	132	8,550	12,000	11	6		4			1	3
Coxsackie	89	1,611	3,824	23.27	12				1	3	
Cuba	30	1,386	3,000	10	1						
Dansville	68	3,758	4,500	15.11	8						
Delhi	45	1,564	3,000	15	4		1				

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—						
					Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
New York—Continued.											
Dobbs Ferry	34	2,083	2,800	12.14	4						
Dundee	15	1,200	1,320	11.38							
Dunkirk	123	9,416	12,500	9.84	8		1				
East Syracuse	23	2,231	2,518	9.14	5			1		2	
Elmira	496	30,893	40,000	12.40	31		4		1	1	3
Fairport	27	2,552	3,000	9	4		1			1	
Fayetteville	33	1,410	1,300	25.37	6						
Fishkill on the Hudson	78	3,617	4,000	19.70	3					1	
Frankfort	63	2,291	2,800	22.50	6						
Franklinville	10	1,021	1,250	8	1						
Fredonia	57	3,399	3,800	15	6					1	
Fulton	111	4,214	6,500	17.08	3		2				
Fultonville	3	1,122	1,006	2.99	1						
Geneva	157	7,557	10,861	14.46	13		4			3	1
Geneseo	13	2,286	3,500	3.71	4						
Gloversville	284	13,864	14,694	19.33	23		4			4	
Goshen	85	2,907	4,500	18.89	8					1	
Greenbush	144	7,301	7,500	19.20	15		5			6	
Greenwich	43	1,663	2,135	20.14	5		1				
Hamilton	36	1,744	2,000	18						1	
Hancock	50	1,279	4,000	12.50	4		1			2	
Hastings on the Hudson	26	1,466	1,700	15.29	5		1				
Holley	22	1,381	1,472	14.95	3		1				
Honeoye Falls	25	1,128	1,280	19.53	1					1	
Horseheads	28	1,716	1,900	14.74			1				3
Hudson	188	9,970	10,000	18.80	23		3			4	2
Huntington	106	3,028	8,253	12.84	10				1	1	
Ilion	63	4,057	4,661	13.52	6		1				
Irvington	20	2,299	2,013	9.93	2				1		
Ithaca	187	11,079	15,000	12.47	24						1
Kingston	408	21,261	23,000	17.74	46		3		1	10	1
Lancaster	40	1,692	3,500	11.43	2		2				
Leroy	31	2,743	3,100	10	2		1				
Lima	40	1,003	2,300	17.43	6						
Little Falls	111	8,783	10,000	11.10	9		2				
Lockport	267	16,038	18,000	14.83							
Malone	97	4,986	5,600	17.32	3					1	
Marathon	27	1,198	1,116	24.19	1		1	1			
Middleburg	45	1,139	1,128	39.89	3		2				
Middleport	15	1,217	1,383	10.85							
Middletown	295	11,977	15,000	19.67	26		4	1	2	6	2
Montgomery	14	1,024	1,000	14	4						
Monticello	14	1,016	1,035	13.53	2						
Moriah	37		2,500	14.80	1		2			4	
Mount Morris	38	2,286	2,200	17.27	1					2	
Naples	15	1,266	2,800	5.36	1		1		1		
Newark	50	3,698	4,500	11.11	11		1			1	
Newburgh	472	23,087	26,000	18.15	55		3			14	2
New York	38,877	1,515,301	1,990,562	19.53	4,843	24	299	391	500	1,590	308
New York Mills	21	2,552	1,400	14	5		1				
Niagara Falls	241	5,502	20,000	12.05	5		12			11	1
North Tarrytown	61	3,179	4,000	15.25	4				1	2	
North Tonawanda	121	4,793	9,000	13.44	1		7			1	2
Norwich	86	5,212	6,004	14.32	3				1	5	
Norwood	17	1,463	1,735	9.80	5		2				
Nunda	31	1,010	3,000	10.33			1				
Nyack	52	4,111	5,603	9.28	4		1			1	
Oneonta	155	6,272	10,000	15.50	18		4			14	
Palmyra	75	2,131	4,000	18.75	8		2				1
Peekskill	164	9,676	11,000	14.91	17		2			8	
Perry	56	1,528	3,500	16	6		1				
Phenix	43	1,466	1,700	25.29	2		2				
Philmont	19	1,818	2,016	9.43	2		1				
Port Byron	36	1,105	1,800	20	6						
Port Ewen	26	1,211	1,000	26	1					2	
Potsdam	83	3,961	5,000	16.60	11		3				
Pulaski	24	1,517	1,577	15.22	5						
Randolph	22	1,201	1,200	18.33	1						
Rhinebeck	61	1,649	3,400	17.65	5					8	

Table of Annual Mortality Statistics in 1,597 Cities and Towns in the United States, etc.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
New York—Continued.											
Richfield Springs	45	1,623	1,650	27.27	4		1			1	
Rosendale	145	1,706	6,125	23.67	1		7	1		6	
Roslyn	141	1,251	10,000	14.10	13		2			3	
Sandy Hill	40	2,895	4,100	9.76	3		2		1		
Saratoga Springs	291	11,795	12,000	24.25	16		5		2	13	
Saugerties	169	4,237	11,000	15.36	26		2				
Schaghticoke	70	1,258	3,500	20	9		5				
Schuylerville	27	1,387	1,300	20.77	2		1				1
Sidney	53	1,358	2,600	20.38	3					1	
Skaneateles	22	1,559	1,526	14.42	4						
Sodus	79	1,028	5,000	15.80	10					1	
South Glens Falls	48	1,606	2,007	23.91	9		1				
St. Regis Falls	22	1,210	2,000	11	2						
Syracuse	1,711	88,143	125,000	13.69	202		38	3	37	39	3
Ticonderoga	60	2,267	5,000	12	8		3				3
Tonawanda	97	7,145	8,000	12.12	11		3			13	2
Trumansburg	25	1,211	1,232	20.29	2		1				
Utica	772	44,007	55,000	14.04	108		6		5	29	1
Valatie	17	1,437	1,164	14.66	2					1	
Walden	36	2,132	3,000	12							
Walton	59	2,299	5,000	11.80	3		2				
Wappinger Falls	62	3,718	3,500	17.71	10					1	
Warsaw	59	3,120	4,200	14.05	2		4			1	
Watertown	343	14,725	21,000	16.33	16		14	1	2	1	
Waterville	25	2,024	1,700	14.71	4					4	
Weedsport	27	1,580	2,000	13.50	2					1	
Wellsville	39	3,435	3,800	10.26	5					1	
Whiteplains	134	4,042	7,361	18.20	14					1	
Whitestown	61	2,808	5,225	11.68	5		2				
Yonkers	743	32,033	40,000	18.58	79		6		3	63	2
Total	79,960		4,527,168	17.66	9,054	28	862	641	773	3,229	585
North Carolina:											
Fayetteville	64	4,222	6,000	10.67	10		3				
Goldsboro	93	4,017	5,700	16.32	9		3	4			
Greensboro	145	3,317	8,000	18.13	24		6				15
Henderson	43	4,191	4,250	10.12	10		2				
Hendersonville	6	1,216	1,600	3.75							
Kinston	34	1,726	3,500	9.71	4		2	1			
Monroe	27	1,866	2,400	11.25	1		1				
Newbern	250	7,843	9,000	27.77	18		4				
Newton	18	1,038	1,500	12	2		1				
Oxford	41	2,907	2,300	17.83	6		1	1			
Raleigh	220	12,678	15,000	14.67	38		3			3	3
Rockingham	22	1,535	1,750	12.57	1		5				
Rockymount	14	1,870	2,600	5.39	2						
Salem	50	2,711	4,550	10.96	2						
Salisbury	212	4,418	5,500	20.36	18		9				
Southport	18	1,207	1,200	15	2			3			
Tarboro	25	1,924	2,500	10	4		2				
Washington	85	3,545	5,500	15.46	10		5				
Weldon	22	1,286	1,450	15.10	1		1				
Wilmington	522	20,056	25,000	20.88	54		12				12
Wilson	44	2,126	4,500	9.78	5		1	2			
Winston	217	8,018	10,000	21.70	48		6		1		18
Total	2,172		123,800	17.54	269		67	11	1	3	48
North Dakota:											
Bismarck	35	2,186	3,500	10	2		1			3	
Total	35		3,500	10	2		1			3	
Ohio:											
Ada	24	2,079	2,700	8.52	4		2			1	
Alliance	91	7,607	8,500	10.71	10				2	9	
Antwerp	10	1,331	1,500	6.67	2		1			1	
Arcanum	36	1,134	1,500	24	2		2		1		
Ashtabula	142	8,338	12,000	11.83	9		2			2	
Athens	34	2,620	3,500	9.71	5						

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from—Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Ohio—Continued.											
Barnesville	58	3,207	4,000	14.63			2				
Bellaire	116	9,934	10,000	11.60	13		6		2		1
Bluffton	12	1,290	1,800	6.67							
Bradford	31	1,338	1,600	19.31	6		4				
Brooklyn	22	4,585	1,796	12.25			1			2	
Bryan	33	3,068	4,000	8.25	7					1	
Bucyrus	72	5,974	7,000	10.29	11		4			3	
Cadiz	24	1,716	2,000	12	4						
Caldwell	2	1,248	1,360	7.35	1						
Cambridge	63	4,361	8,000	7.88	10		2		1	3	
Canton	284	26,189	40,000	7.10	29		20			10	3
Cardington	16	1,428	1,600	16						4	
Carey	15	1,605	2,000	7.50							
Carrollton	16	1,228	1,500	10.67	3		1			3	
Carthage	24	2,257	2,500	9.60	3						1
Celina	68	2,702	3,500	19.43	2		1	8	3	4	1
Chillicothe	229	11,288	15,000	15.27	25		11		1	11	
Cincinnati	5,565	296,908	405,000	13.74	675		101	18	16	135	34
Circleville	110	6,556	7,000	15.73	5		5			1	
Clyde	43	2,327	3,000	14.33	6		1				
Columbiana	26	1,112	1,500	17.33	1		1				
Columbus	1,219	88,150	135,000	9.03	201		29	2	6	18	
Conneaut	59	3,241	5,000	11.80	8					3	
Coshocton	56	3,672	5,000	11.20	7				1		
Cuyahoga Falls	28	2,614	3,500	8			1			1	
Degraff	9	1,076	1,300	6.92	2		1				
Delaware	85	8,224	9,000	9.44	15		3				
Delta	12	1,132	1,400	8.57							
Doylestown	10	1,131	1,200	8.33	2					1	
East Liverpool	154	10,956	15,000	9.74	14		9	6		5	3
East Palestine	11	1,816	24,000	4.58	2						1
Eaton	80	2,934	3,000	26.67							
Elmore	6	1,198	1,200	5	2					1	
Fairport	28	1,171	1,570	17.83							
Findlay	193	18,553	20,000	9.65	30		8		1	4	
Forest	7	1,126	1,400	5	1		1				
Franklin	30	2,729	3,000	10	3						
Fremont	82	7,141	8,000	10.25	8		3			6	
Galion	60	6,326	8,500	7.06	8		2		1	1	1
Gallipolis	118	4,498	6,000	19.67	15		2	1		3	
Geneva	28	2,194	2,800	10	3		1				
Germantown	16	1,437	2,000	8	1		1			1	
Glendale	24	1,444	1,447	16.59	2						
Greenville	54	5,473	6,000	9	6		3		1	4	
Hamilton	328	17,565	24,000	13.67	43		3		2	2	
Hartwell	18	1,507	2,000	9	3		1				
Hicksville	10	2,141	2,000	5	3		2				
Hillsboro	21	3,620	4,800	4.38	3		4				
Holgate	15	1,134	1,300	11.54	1						
Hudson	19	1,143	1,800	10.56	1				1		
Huron	16	1,380	2,000	8							
Ironton	180	10,939	12,000	15	17		12			6	1
Jackson	68	4,320	6,000	11.33	6		8		1	2	1
Kent	56	3,501	4,000	14	7		3				
Kenton	64	5,557	8,000	8	11					3	
Lancaster	123	7,555	10,000	12.30	21		6			1	
Lorain	115	4,863	12,000	9.58	4		4		1	11	1
Lebanon	62	3,050	3,500	17.71	6					1	
Leetonia	37	2,826	3,500	10.57	3		1		3	1	
Leipsic	15	1,353	2,100	7.14	2		2				
Lima	447	15,981	25,000	17.84	34		6		1	17	3
Lockland	31	2,474	3,000	10.33							
Logan	47	3,119	3,500	13.43	9		2				
McComb	11	1,030	1,500	7.33	3						
McConnellsville	29	1,771	1,765	16.43	9						
Manchester	43	1,965	2,500	17.20	10					3	
Marietta	115	8,273	15,000	7.67	4		7			8	3
Marion	96	8,327	12,000	8			4			4	
Martins Ferry	122	6,250	7,000	17.46	17		10		2	4	
Marysville	34	2,810	3,500	9.71	2		1			1	
Massillon	114	10,092	13,000	8.77	13		6			6	2

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

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Ohio—Continued.											
Miamisburg	38	2,952	4,000	9 50	8		1				
Middleport	47	3,211	3,000	15 67	17					2	
Middletown	98	7,681	10,000	9.80	13	2					
Millersburg	26	1,923	2,000	13	3						1
Minerva	13	1,139	1,300	10	4						
Mingo Junction	20	1,856	2,500	8	2					1	
Montpelier	11	1,293	2,200	5.27	3		1				
Napoleon	34	2,764	4,250	8	4		1		1		
Nelsonville	40	4,558	6,000	6.67	3		3			1	
New Bremen	7	1,239	1,500	4.67			1				
New Lexington	23	1,470	2,000	11.50	5					1	
New London	13	1,096	1,500	8.67						1	
New Philadelphia	62	4,456	5,000	12.40	4		2			4	
New Richmond	20	2,379	2,000	10	1						
New Straitsville	27	2,782	2,800	9.64	1					1	
Niles	90	4,298	7,000	12.86	2		1		1	3	
North Amherst	12	1,648	2,000	6							
Norwalk	86	7,195	7,500	11.47	10		2	1		8	
Oak Harbor	14	1,681	2,000	7	1		1				
Oberlin	58	4,376	4,600	12.61	7		3				2
Orrville	22	1,765	2,000	11	4		1				
Ottawa	16	1,717	2,300	6.96	2		2				
Painsville	84	4,755	6,000	14	8		2		1		1
Piketon	5	1,022	800	6.25							
Pleasantridge	14	1,027	1,250	11.20							
Plymouth	6	1,133	1,200	5			2				
Pomeroy	60	4,726	5,000	12	3		4	2			
Portsmouth	231	12,394	18,000	12.83	28		7	1		11	
Ravenna	43	3,417	4,500	9.56	5		1		7		
Sabina	13	1,080	1,500	8.67	2						
Shawnee	36	3,266	4,000	9	6		1		1		
St. Bernard	54	1,779	2,850	18.95	3		3			15	
St. Mary	60	3,000	6,000	10	6					1	
Salem	69	5,780	8,000	8.63	4		4	1	2	1	11
Salineville	34	2,369	2,800	12.14			1	2		7	2
Sidney	48	4,850	5,000	9.60	8		1			3	
Somerset	13	1,127	1,500	8.67						1	
South Charleston	16	1,041	1,200	13.33	2		1				
Springfield	452	31,895	38,000	11.89	44		14	11	3	21	13
Tiffin	126	10,801	15,000	8.40	17		2				
Uhrichsville	45	3,842	4,500	10	7			2	1	1	
Union	1	1,293	300	3.33	1						
Urbana	83	6,510	8,000	10.38	18				1	5	1
Versailles	18	1,385	1,700	10.59	4						
Wapakoneta	47	3,116	4,500	10.44	6		1				
Warren	83	5,973	10,000	8.03	13		1				
Waverly	50	1,567	2,000	25				1	2	1	
Wellington	20	2,069	3,000	6.67	1						
Wellston	84	4,377	10,000	8.40	13		1		2	9	
Wellsville	88	5,247	6,000	14.67	1		3		1	6	
Willoughby	33	1,219	1,500	22						1	
Wilmington	56	3,079	4,000	14	11		2				
Wyoming	13	1,454	1,800	7.22	1						
Xenia	136	7,301	8,500	16	28		1			3	1
Youngstown	463	33,220	50,000	9 26	29		19	6	4	5	2
Total	15,122		1,301,728	11.62	1,758	2	403	62	74	421	90
Oregon:											
Astoria	108	6,184	9,000	12							
Marshfield	220	1,461	20,000	9.09							
Total	328		29,000	11.31							
Pennsylvania:											
Allegheny	1,778	105,287	130,000	13.68	155		79	15	4	41	9
Altoona	587	30,337	42,000	13.98	46		16		3	34	8
Ambler	29	1,073	1,700	17.06	2						
Ashley	75	3,192	3,600	20.83	2					2	
Athens	54	3,274	3,500	15.43			2	2			
Avenue	17	1,453	1,500	11.33				5	2	6	4

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Pennsylvania—Cont'd.											
Avoca	30	3,031	5,000	6	1		1			2	
Beaver Falls	134	9,735	12,000	11.17	19		11			5	
Bellevernon	4	1,147	1,000	4							
Bellevue	23	1,418	3,500	6.43							
Berwick	35	2,701	3,000	11.67						1	
Bethlehem	111	6,762	8,000	13.88	1		3			3	
Blakely	56	2,452	5,000	11.20						6	
Bloomsburg	60	4,635	8,000	7.50					1	4	
Boyertown	19	1,436	2,000	9.50	1						
Braddock	264	8,561	11,000	24			6	3		3	
Bradford	159	10,514	18,500	8.59	10		5			17	
Bridgeport	50	2,651	3,500	14.29						1	
Bristol	103	6,553	7,000	14.72	10					1	
Brookville	23	2,478	2,700	8.52	3						
Brownsville	35	1,417	1,477	23.70			1				
Butler	137	8,734	11,000	12.45	10		1		1	5	2
Canton	18	1,393	2,000	9	1						
Carlisle	141	7,620	10,500	13.43	12		1	2	1	2	
Catasauqua	42	3,704	3,700	11.35	3		2				1
Catawissa	20	1,809	3,000	6.67	2						
Centralia	35	2,761	3,000	11.67	2				1	6	
Chambersburg	149	7,863	9,000	16.56	11				8	3	
Chester	374	20,226	25,000	14.96	40		5		4	10	4
Clarendon	4	1,297	400	10	1						
Clarion	18	2,164	2,500	7.20	2						
Connellsville	66	5,629	6,800	9.71			1				
Cressona	30	1,481	1,500	20						2	
Danville	60	7,998	9,000	6.67			2	1		3	1
Darby	20	2,972	4,000	5							
Dowingtown	36	1,920	2,074	17.36	2		1				1
East Brady	12	1,228	1,300	9.23						2	1
Elizabethtown	5	1,218	2,000	2.50	1						
Emporium	33	2,147	2,600	12.70	1				2	5	
Erie	624	40,634	57,000	10.95	68		12	3	2	4	1
Etna	64	3,767	3,700	17.30							
Everett	22	1,679	2,000	11							
Fracksville	31	2,520	3,000	10.33	2				1	1	
Franklin	67	6,221	8,000	8.38						2	
Gettysburg	54	3,221	4,000	13.50			2			3	
Greensburg	62	4,202	7,000	8.86	4		4			3	
Hallstead	20	1,167	2,000	10	4						
Harrisburg	600	39,385	50,000	12	45		10		10	14	
Hollidaysburg	30	2,975	3,119	9.62							
Honesdale	50	2,816	3,500	14.29							
Houtzdale	12	1,234	2,100	5.71			1			2	
Hughesville	15	1,358	1,600	9.38	1						
Jeannette	61	3,296	7,000	8.73	6					2	
Johnsonburg	31	1,280	3,500	8.86							
Johnstown	369	21,805	27,000	13.70	28		21	4	10	4	3
Kingston	71	2,381	3,200	22.19	1				2	3	
Kittanning	16	3,095	5,000	3.20			2			1	
Knoxville	17	1,723	1,000	17							
Kutztown	6	1,595	1,500	4	1		2				
Lancaster	623	32,011	50,000	12.45	40		36		4	14	
Latrobe	45	3,589	4,000	11.25	4					2	
Lehighton	58	2,959	4,800	12.08	4					2	
Lewistown	18	3,273	3,500	5.14							
Lewisburg	41	3,248	3,300	12.42	6		1			1	
Lititz	24	1,494	1,800	13.39							
Lockhaven	75	7,358	8,500	8.82			1			1	
McDonald	27	1,698	4,500	6						2	
McKeesport	429	20,741	30,000	14.30	11	1	8			22	
McSherrystown	35	1,020	1,500	23.33	9			1		7	
Manheim	27	2,070	2,200	12.27			1				
Meadville	122	9,520	12,000	10.17			1				
Mechanicsburg	60	3,691	4,304	13.92	2		1				
Media	40	2,736	3,500	11.43	7						1
Meyersdale	37	1,847	2,700	13.70	2			1		4	
Millersburg	17	1,527	1,600	10.63	1						
Millerstown	5	1,162	600	8.33							

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Pennsylvania—Cont'd.											
Monongahela	75	4,096	5,000	15	2		4			15	
Montrose	25	1,735	1,800	13.89	1						
Morrelville	12	2,827	3,500	3.43			1	1		1	
Morrisville	14	1 203	1,400	10	1		1			1	
Mount Carmel	290	8,254	12,000	24.17			3	10	1	12	
Mt. Holly Springs	11	1,190	1,250	8.80							
Nesquehoning	24	1,655	2,000	12	1			3		4	
New Brighton	84	5,616	7,000	12	9		7			2	
Newcastle	251	11,600	25,000	10.04	1		6			17	3
Newhaven	13	1,221	1,800	7.22	1						
Newtown	18	1,213	1,400	12.86	2						
Norristown	280	19,791	22,500	12.45	25		5			2	7
Northeast	29	1,538	2,500	11.60	1					2	
Northumberland	29	2,744	2,700	10.74	4		1			1	
North Wales	16	1,060	1,200	13.33	1		1			2	
Oil City	132	10,932	15,000	8.80	7		8			6	
Osceola Mills	20	1,730	2,000	10	1			2	1	4	
Parkesburg	39	1,514	1,800	20.56						5	
Phenixville	118	8,514	8,500	13.88	8					2	
Philadelphia	22,735	1,046,964	1,214,256	18.72	2,388		401	64	282	1,474	271
Pine Grove	14	1,103	1,200	11.67	3					2	
Pittsburg	4,745	238,617	287,500	16.54	317		184	90	22	135	108
Pittston	228	10,302	20,000	11.40	3		2	5	1	32	1
Port Carbon	27	1,976	2,700	10	1					1	
Quakertown	49	2,169	3,000	16.33	3		2			2	
Reading	1,024	58,661	75,000	13.65	93		24	2		27	
Reynoldsville	36	2,789	3,000	12			1		1	6	
Royersford	8	1,815	2,200	3.63							
St. Clair	151	3,680	6,000	25.17	3			2		14	2
Saltsburg	9	1,088	1,400	6.43							
Scranton	1,552	75,215	105,000	14.78	70		13	22	1	112	5
Scottdale	38	2,693	3,700	10.27			9			2	
Schuylkill Haven	36	3,088	3,800	9.47	3		2		1	1	
Shamokin	294	14,403	20,000	14.70	16		1	23	2	11	
Sharpsburg	85	4,898	7,000	12.14			3		3	4	
Sharpsville	30	2,330	3,000	10	1					6	
Shippensburg	29	2,188	4,000	7.25	6		1				
Somerset	27	1,713	2,400	11.25							
South Bethlehem	209	10,302	14,000	14.93	20		4		2	15	6
South Fork	34	1,295	2,500	13.60	1			5		6	
Steelton	161	9,250	10,000	16.10						3	
Sugar Notch	14	2,586	1,783	7.85			2				
Sunbury	121	5,930	10,000	12.10			6	2		2	
Susquehanna	56	3,872	4,000	14							
Tarentum	72	4,627	5,000	12.40			2				
Tidioute	15	1,328	1,500	10			1				
Towanda	60	4,169	5,000	12	5					2	
Tremont	37	2,064	2,200	16.81						12	
Tunkhannock	20		2,500	8							
Tyrone	82	1,253	7,000	11.71			2			7	
Upland	34	2,275	2,000	17	6					2	
Verona	24	1,477	2,000	12	3						
Washington	104	7,063	8,500	12.24			1	3			
Waynesboro	30	2,101	3,000	10							
Weatherly	52	2,961	4,000	13			1				
Wellsboro	30	2,961	2,900	10.34	1		1			1	
West Bethlehem	43	2,759	4,000	10.75					1	1	1
West Bridgewater	12	1,177	1,200	10	1		1				
West Conshohocken	44	1,666	2,500	17.60			2				1
West Fairview	13	1,137	1,200	10.83						1	
West Newton	33	2,285	3,500	9.43	5		1			1	
West Pittston	88	3,906	6,450	12.39	3		2		3	2	
Wilkesbarre	709	37,718	55,000	12.89	3		15		12	37	
Wilkinsburg	84	4,662	14,000	6			2				
Williamsport	231	27,132	35,000	6.60	19	1	7			4	1
Wrightsville	24	1,912	2,400	10							
York	361	20,793	25,615	14.09	27		12	4	4	22	1
Total	44,045		2,816,450	15.64	3,649	2	982	275	388	2,281	422

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN THE UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.	Whooping cough.
Rhode Island:											
Barrington	22	1,461	1,723	12.77			1				
Bristol	130	5,478	6,934	18.75	10		1	4	1	1	
Burrillville	92	5,492	5,784	15.91	10						
Central Falls	223	15,828	16,892	13.20	18				2	3	1
Coventry	103	5,068	5,092	20.21	9		1			2	8
Cranston	183	8,099	9,714	18.85	22		3		2	4	3
Cumberland	•166	8,090	6,782	24.48	23		1	1		3	
East Greenwich	58	3,127	3,176	18.26	13		1				1
East Providence	163	8,422	10,987	14.84	10		2	1	2	2	3
Foster	28	1,252	1,147	24.41	1						
Glocester	30	2,095	1,610	18.63					1		
Hopkinton	46	2,864	2,692	17.08	6						
Johnston	204	9,778	12,182	16.75	20		1	1		4	2
Lincoln	110	20,355	8,912	12.34	16			1		6	1
Little Compton	22	1,128	1,123	19.59	1		1				
Middletown	14	1,154	1,413	9.91							
Newport	356	19,457	21,500	16.56	41		2		1	4	9
New Shoreham	24	1,320	1,305	19.16	2					2	
North Kingstown	63	4,193	4,913	12.82	7						
North Providence	40	2,084	2,500	16	1					1	
North Smithfield	52	3,173	3,000	17	16					6	
Pawtucket	600	27,633	35,000	17.14	62		9	3	1	29	2
Portsmouth	19	1,949	1,883	10.09	2						
Providence	2,805	132,146	154,000	18.18	321		24	18	11	91	16
Richmond	27	1,669	1,636	16.50	1					1	1
Scituate	68	3,174	3,504	19.41	6						
Smithfield	41	2,500	2,337	17.54	8		2				
South Kingstown	71	6,231	5,320	13.35	1		1			1	1
Tiverton	45	2,837	3,027	14.87	1		2			1	1
Warren	79	4,489	4,500	17.56	7		2	1		3	
Warwick	366	17,761	23,117	15.83	29		1	1	1	16	4
Westerly	125	6,813	7,913	15.69	5		5		1	2	2
Woonsocket	464	20,830	26,000	17.84	54		5	1	1	50	2
Total	6,839		397,618	17.19	723		65	32	25	232	29
South Carolina:											
Aiken	47	2,362	3,000	15.67	11						
Camden	26	3,533	3,500	7.43	3						
Charleston *a*	1,590	54,955	65,165	24.39	184		40		6	2	15
Florence	96	3,395	5,500	17.46			3			3	1
Greenville	150	8,607	12,000	12.50	17		2				3
Newberry	40	3,020	5,000	8	9		1				
Pelzer	49	1,878	6,000	8.17							
Rock Hill	20	2,744	5,000	4							
Summerville	37	2,219	3,000	12.34	6						
Total	2,050		108,165	18.95	230		66	32	25	232	29
South Dakota:											
Canton	7	1,101	1,800	3.89	1						
Deadwood	36	2,366	6,000	6	3					4	
Sioux Falls	87	10,177	10,000	8.70	9		5	1		1	2
Vermilion	22	1,496	2,500	8.80	3					1	
Total	152		20,300	7.48	16		5	1		6	2
Tennessee:											
Coal Creek	85	1,865	2,500	34	6		11	2		5	
Henderson	25	1,069	2,000	12.50			6				
Jackson *b*	243	10,039	16,000	15.19	40		50	10		7	10
Lebanon	50	1,883	3,000	16.67						1	
McMinnville	6	1,677	3,000	2	4		1				
Maryville	30	1,686	3,000	10	7		5			2	
Nashville	1,636	76,168	87,754	18.64	220		45	3		20	3

a 447 white and 1,143 colored and black. Mortality per 1,000: 15.52 white; 31.49 colored and black.

b White population, 10,000; colored population, 6,000; deaths of white, 110; colored, 133.

TABLE OF ANNUAL MORTALITY STATISTICS IN 1,597 CITIES AND TOWNS IN UNITED STATES, ETC.—Continued.

Cities or towns.	Total deaths from all causes.	Population, United States Census of 1890.	Estimated population.	Annual mortality per 1,000 of the estimated population.	Deaths from— Phthisis pulmonalis.	Smallpox.	Enteric fever.	Measles.	Scarlet fever.	Diphtheria and membranous croup.
West Virginia:										
Benwood	68	2,934	4,000	17	4		1			
Buckhannon	12	1,403	2,000	6	2		3			
Huntington	148	10,108	15,000	9.87	21		6		1	7
Keyser	5	2,165	3,000	1.67	1		3			1
Wellsburg	80	2,235	3,000	26.67	7		2			1
Wheeling	602	34,522	38,000	15.84	69		18	10	1	13
Total	915		65,000	14.08	104		33	10	2	22
Wisconsin:										
Antigo	43	4,424	5,000	8.60						
Ashland	182	9,956	18,000	10.11	20		2			11
Bayfield	10	1,373	1,800	5.56	4					
Burlington	22	2,043	2,400	9.17	3		1			1
Centralia	35	1,435	2,045	17.11	2		1			22
Chippewa Falls	112	8,670	9,000	12.44	8		1	3		
Clintonville	12	1,466	1,700	7.06	1					2
Cumberland	16	1,219	1,400	11.43	3		1			
Darlington	21	1,589	2,100	10	1				1	
Depere	62	3,625	3,600	17.22	7			1		5
Dodgeville	16	1,722	2,000	8	3					
Durand	40	1,154	1,500	26.67	5				2	2
Elroy	20	1,413	1,500	13.33	5		2			
Evansville	22	1,523	2,000	11	2					
Fond du Lac	163	12,024	16,000	10.19					1	2
Fort Atkinson	25	2,283	2,800	8.93	3					
Greenbay	199	9,069	22,000	9.05	12		2			14
Hayward	28	1,349	1,600	17.50	3					
Jefferson	20	2,287	3,000	6.67	3		1			
Kaukauna	65	4,667	6,000	10.83	12			1		
Kewaunee	18	1,216	1,530	11.76	18					
Lake Geneva	30	2,297	2,500	12	4					1
Lancaster	27	1,543	2,250	12	1					
Manitowoc	129	7,710	10,500	12.29	8		3			4
Mauston	17	1,343	1,700	10	1					
Mazomanie	9	1,034	1,500	6	1					
Medford	3	1,193	2,000	1.50						
Menasha	40	4,581	8,000	5						1
Milwaukee	3,606	204,468	275,000	13.11	346		31	36	3	138
Oconto	59	5,219	6,000	9.83	8					1
Oshkosh	250	22,836	30,000	8.33	23		3	1		1
Platteville	23	2,740	3,500	6.57	6					
Port Washington	38	1,659	3,000	12.67	3		1			1
Prairie du Chien	48	3,131	3,200	15	6		2	5		2
Reedsburg	13	1,737	2,500	5.20	2			1		1
Rhinelander	32	2,658	5,000	6.40	3					
Rice Lake	38	2,130	4,000	9.50	4					7
Richland Center	20	1,819	2,500	8	4					1
Sheboygan	268	16,359	24,000	11.17	21		2	1	2	7
Shullsburg	17	1,393	1,400	12.14						
Superior	264	11,983	35,000	7.54	43		12		1	6
Tomah	20	2,199	3,000	6.67	3					
Tomahawk	16	1,816	2,600	6.16			1			
Two Rivers	57	2,870	5,400	10.56	6		2		1	7
Waupaca	31	2,127	3,000	10.33	1					1
Westbend	25	1,296	3,000	8.33	1		2			1
Whitewater	70	4,359	3,500	20	6					
Williamsburg	60	3,133	3,800	15.79						2
Total	6,341		554,825	11.43	630		70	49	11	241
Wyoming:										
Buffalo	4	1,087	750	5.33						
Total	4		750	5.33						

YELLOW FEVER:

Pink HB
No 4

ITS NATURE, DIAGNOSIS, TREATMENT, AND PROPHYLAXIS,

AND

UARANTINE REGULATIONS RELATING THERETO,

BY

OFFICERS OF THE U. S. MARINE-HOSPITAL SERVICE.

(From Annual Report Marine-Hospital Service, [illegible].)

TOGETHER WITH

AN ABSTRACT OF THE REPORT OF THE MEDICAL OFFICERS DETAILED AS A COMMISSION TO INVESTIGATE THE CAUSE OF YELLOW FEVER.

PREPARED UNDER DIRECTION OF
THE SUPERVISING SURGEON-GENERAL.

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WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

#4

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YELLOW FEVER, ITS NATURE, DIAGNOSIS, TREATMENT, AND PROPHYLAXIS, AND QUARANTINE REGULATIONS RELATING THERETO.

The following articles and letter of transmittal were published and transmitted in book form to quarantine and health officers, and others:

LETTER OF TRANSMITTAL.

TREASURY DEPARTMENT,
OFFICE OF THE SUPERVISING SURGEON-GENERAL,
MARINE-HOSPITAL SERVICE,
Washington, D. C., June 15, 1898.

To the Honorable
The SECRETARY OF THE TREASURY.

SIR: I transmit herewith, arranged for publication with your approval, a number of articles by officers of the Marine-Hospital Service relating to yellow fever.

These articles have been prepared by my direction by the officers of the service, whose valuable work in connection with yellow-fever epidemics has made them particularly well qualified for conveying the information herein contained.

No similar work has ever been published, and while it is to be hoped that with the advancement of scientific medicine a positive knowledge of the true nature of yellow fever will before long be acquired, and that the measures for its prevention will be more accurate and certain through this acquired knowledge, yet the information herein given is at the present time pertinent and necessary.

It is proposed to transmit this volume not only to the medical officers of the Marine-Hospital Service, but to State and local quarantine officers and to others to whom a plain statement of the method of diagnosis of yellow fever, its treatment, and the measures for the prevention of its introduction into the United States, and for its suppression when it has passed the boundaries of this country, will be of immediate value.

I have the honor to remain, respectfully, yours,

WALTER WYMAN,
Supervising Surgeon-General, Marine-Hospital Service.

Approved:
L. J. GAGE,
Secretary.

CIRCULAR LETTER ON DIAGNOSIS OF YELLOW FEVER ADDRESSED TO CERTAIN PHYSICIANS ON THE GULF COAST.

By Surg. R. D. MURRAY.

MOBILE, ALA., *May 28, 1898.*

DEAR DOCTOR: I have prepared a short letter on the importance of early diagnosis of cases of yellow fever, which I have arranged to send to every physician on the coast. As you are associated with me officially I will repeat to you what I have written them and add some arguments to increase your usual interest and perhaps give you some extra aids in prompt diagnosis.

* * * * * * *

DISCOVERY OF FIRST CASES ENABLES SUPPRESSION OF EPIDEMICS.

Spread of disease can be prevented.

It is well known that first cases can be prevented from conveying the disease. Every prevalence for years has shown this, and the results of prompt and proper action at Perkinston, Miss., and Franklin, La., and in other towns during the past season should stimulate every physician to "catch on" to the first cases. A man is not a scoundrel because he suspects a case, nor a fiend because he finds a first case. But a doctor is culpable if he slurs over a case and hopes against his judgment in order to save his precious record with a vacillating public. I can not quite agree with Dr. Guiteras that we can inure our people to prompt announcements of suspicion and actual cases, but I know the people will fully trust us if our words and conduct are apparently in behalf of their final interest.

It is easy to call every illness "yellow" a month after other towns have quarantined, but it is not easy to decide on an individual case when no warning has been given and no source of infection is read about every morning.

DO NOT BE DILATORY IN REPORTING FIRST CASES.

It will not do to advocate the notion that any place is free from the chance of infection, nor to insist that all the old-time symptoms must be present, with a death or two added, before one suffers with a twinge of honesty and risks his present prosperity by doing what should be done with a first case.

False alarms not so bad as neglected cases.

Scares and false alarms are hurtful, but they do not usually kill. I would as little trust an alarmist as one who "would die before he would report a suspicious case." Duty to one's self, to one's family, and to all communities demand careful observation of every fever case, with proper action in case there is reason to suspect yellow fever. A lot of "rejected" cases have spread the infection. It is established that only yellow fever makes yellow fever, but it is not so well known that a mild case of yellow fever is as dangerous as a case that ends fatally in sixty hours. I think the mild case much more dangerous than a "genuine" one.

"MILD CASES" ARE DANGEROUS DISEASE SPREADERS.

Mild cases most dangerous from sanitary standpoint.

Now, to quicken your senses, to increase your usefulness, and to assist you in giving your best efforts to your people I presume to give you some hints as to discovery of first cases. I do not claim to be expert, but I have a long record of lucky decisions which warrant me in speaking freely to those who have been so fortunate as to have an abiding place or a place called "home." I am not infallible, but I am in earnest in my desire to do good to others and to save my people from the horrors of an epidemic and the provocations of quarantine. Mild cases of yellow fever are the mildest cases of disease that can be seen. Walking cases, nursing cases, and transient cases are more common than doctors realize. Mild cases transmit infection as easily and effectually as bad cases, and thus make "genuine" cases in the proper persons. Mild cases are not so quickly apprehended as severe ones, but they can be isolated more easily and at less expense than bad ones. Mild cases are the cases to look out for.

Don't wait for black vomit before announcing.

It is not true that a prevalence of the disease must be begun by a death or black vomiting. It is true that a walking case introduced the disease into a village last year where the earmarks of yellow fever were shown the best, and the results were worst in comparison with all other infected towns of which there is a record.

Hibernation.

I do not believe in recrudescence or hibernation of the fever in small towns or in the country, but many health officials do, and as there is a possibility that all is not known of past epidemics and that there is much to be learned yet of the yellow-fever pest, it behooves us to be watchful—first, for the sake of our professional probity, and second, in the interest of our people.

I am reiterative in order to gain your attention. Pardon me if I seem to be prolix.

POINTS TO BE CAREFULLY NOTED.

First. As to the region lately beset by the Cuban plague, permit me to remind you of what the doctors think—i. e., that the disease recurs; this remark is to prepare you for rumors that there is yellow fever in your practice or community *now!* So be prepared to affirm or deny by the card. Note taking is a good thing for doctors!

Keep careful notes.

Second. If there is reported yellow fever within the communications of your place, suspect every case of febrile disease but say nothing! Get to thinking! Here is the chance for careful observation and some taking of notes. Not long ago a physician blundered as to the date of his first visit! His memory of the pulse, temperature, and nausea was of same sort—his patient died.

Initial chill.

Duodenal pain.

Swollen lip.

Third. If called to any person who sickened in the night or early morning and complains of headache and malaise or body and leg ache with some stomach distress, suspect the case and make inquiry as to where he got it. A chill is called for in the books, but one sufficiently severe to be told of to you is rare; there will be a story of chilliness or waking up in discomfort. Distress in the early morning is a rule; a failure to eat a good breakfast is a bad omen, but hints at a mild case. Fever of 101 to 103 with pulse of 110 to 120; cutting pain through the forehead, with aching eyes; fullness of eyes with some pain and suffusion, generally with injection are probable signs. The back and thighs will be sore in a severe case; there is some soreness in the mildest cases. Severer cases will have pain in back of neck and in calves. Ask few questions. Press firmly and deeply over where you think the gall bladder lies and you will generally elicit a squeak—don't mention it! The face will be full and less mobile than in health with a fullness of the upper lip rendering a smile less gracious.* These signs depend somewhat on an acquaintance with the person. The cheeks will be of a dusky red color—more or less—and depending on the patient's color;

---

*Passed Assistant Surgeon White reports that he made two diagnoses with the swollen upper lip as the first noticeable symptom.

sometimes faintly purplish. Sweating will diminish these face signs in a few hours. The injection of the sclerotics will increase until after thirty-six hours some yellowing may be observed; in children, the eyes will remain pearly excepting the suffusion and the red streaks; some exceptions. Frequently pressure on the eye balls will cause complaint—sure to do so in bad cases. Primary complete or semi constipation is always present. I never heard of a diarrhœic person being attacked. The cases you hear of will bear explanation or further inquiry.

Constipation.

Sluggish circulation.

The circulation in the skin will be faulty; the skin may be streaked by the passing finger or paled for a quarter of a minute by pinching; this is a good sign, and best after thirty-six hours. The skin will be moist, as a rule, and will keep moist to the end, whether medicine is given or not. In diagnosis early or for first cases don't look for yellow skin. The pain of back and legs will be in the muscles and not in the bones and joints; you can make this point by care; squeeze the thighs or calves. Note that unless there is nausea or headache the person lies quiet. (Vide dengue.) There will be less rapidity of the pulse than the height of fever warrants, judging from lung disorders and enteric fever. Do not blunder over one who smokes too much, for his pulse will count less when he reduces his daily quantity or has to quit smoking. Also, consider the effect of your presence on your patient's excitability. The pulse should be counted without the patient's knowledge. After two and a half or three days the pulse will fall below 70 and later on lower yet; fright and irritations will prevent the slow beating from being observed.

Pulse rate.

The above signs are sufficient to warrant isolation and disinfection of all discharges, clothing and discarded bedding, even if there is no known fever within a thousand miles. Also, warrant for sending for me if you need me. Please note that these signs may be in minimum—any old nurse can comprehend the maximums. After sixty hours there should be some albumen in the urine—it is possible for no urine to be procured and that no albumen is found. In women urine is not reliable; in children it is difficult to get. But it must be obtained. Do not confound albumen with mucin and do not treat other symptoms lightly because you do not get albumen.

Urine.

Stools.

At this stage some brown mucus, or black discharges, or "bismuth" stools may be looked for rather early in mild cases—may be late in severe ones. This is only confirmatory; rather late for diagnosis. So with nausea and vomiting. Mild cases suffer with distaste for usual food only.

Anorexia.

Of course there is anorexia from the beginning; usually vomiting of the last food taken; bile will be vomited early if the early nausea is not checked; no bile will be vomited after about thirty-six hours if the patient has had proper bowel actions.

Pyloric regurgitation.

After vomiting of last food taken and a little bile the vomit will usually be white, and will remain so until blood oozes into the duodenum or stomach. As to black vomiting, do not be hypercritical, the chances are vastly in favor of yellow fever. Please notice the hiccough and retching, and listen to the black fluid regurgitating through the pylorus into the stomach. But this is rather late for diagnosis of a first case, and is not applicable in mild cases. Mild cases demand examination of the feces. Always consider the chances of infection to and from your patient.

DIFFERENTIAL DIAGNOSIS.

Differentiation from dengue.

Yellow fever is like a language; you should know something of others. Differentially considered, dengue has a demonstrable rash in the fauces always, between the shoulder blades, generally, and often over the big joints and on the trunk. The pains of dengue are *in* the bones and joints. A dengue patient is in pain and can not lie still—he don't want to get up. Yellow fever pains, except the head, are in the muscles, and the patient after four or five days is comfortable *in* bed, but wants to get up and do a lot of work. He gets up only to faint and return to bed. The dengue patient gets up, but keeps on growling about his pains. This is a late distinction, but it is valuable.

From malaria.

Malaria is usually prodromed for some days by malaise, loss of appetite, discontent, and a general tired feeling. It nearly always attacks in the daytime or when the victim is at his work, and is ushered in with a positive chill. Constipation is the rule, but not so marked a feature as in yellow fever. The malarial tongue is full—swelled—too big for the mouth—tooth marked and heavy coated, with white edge and yellow or dirty top area. A yellow-fever tongue is rarely indented—if it is, there is malaria in the patient; it soon shrinks and gets a red edge and red tip; the red tip is diamond-shaped, the front of the diamond being made by the edges. I do not know about the congestion of the vessels under the tongue in yellow fever and the paleness of same in malaria. You, may be, will have a chance to make observations.

Malarial vomiting is attended with more bile than is usual in yellow fever; this is a guess-point in diagnosis, but the statement is true. Malarial attacks generally permit the fever to decline without medicine and the fever will not cease unless medicine is given. Another good point in differentiation is the presence or absence of labial herpes in convalescents, particularly in young persons; herpes does not occur in yellow fever cases; it is common in malaria. Of course, this is a late sign so far as the individual is concerned, but it has aided me much in giving a hint as to what the other sick one suffers with.

Malaria and dengue.

As a hint for you to consider in deciding on the first case permit me to say that the yellow fever patient gets up "all knocked out; was never so weak in my life after so short a sickness;" the dengue patient gets up "sore and tired; ache all over yet;" the malarial patient is able to work every other day. Another hint, but late for diagnosis: the yellow fever patient is mentally alert; the dengue patient complains much; the malarial don't care much. These points do not apply to individual cases, but are valuable if you have a number of patients to visit.

I have given you sufficient reasons, symptoms, and signs to either put you on your guard or to permit you to act for the benefit of all. Yellow fever is not a "bogey," neither is it uncontrollable.

I hope you will duly consider the *possibility* of cases occurring in your rounds and also the importance of early action in first cases.

I am at liberty to visit you on call by letter or telegram at any time at no expense to you or your clients, and to the best of my ability and the limit of my time I will be glad to serve you.

Please notice that rumors of fever are plenty here and there, and consider that a prompt denial will oftentimes prevent a panic; also a prompt notice will save lives by permitting orderly exit from danger centers.

Examination of blood.

The service has arranged to have samples of suspected blood examined by the new agglutinative test by Dr. Archinard, of New Orleans. Samples of malarial blood can be examined in the hospital at Mobile. If you wish special instructions please make request of me.

In return for what I hope to do for you I request that you send me, at least, a weekly report of health conditions in your region and that you inform me in detail of all rumors and suspected cases. As I am pretty well acquainted with the town and people it is needful that I get names and addresses. Sometimes it may be advisable for me to go in person, and if I know the residence can save much time by going direct from depots. Again, if I have names I can from time to time refute the secondary rumor without doubt as to persons and places.

I fear I have tired you, but I am so desirous of enlisting your aid and arousing your interest in this very important matter that I am willing to be blamed for prolixity.

Command me in any way, personal or professional.

Yours, sincerely,

R. D. MURRAY,
Surgeon, Marine-Hospital Service.

DIAGNOSIS OF YELLOW FEVER.

By Acting Asst. Surg. JOHN GUITERAS.*

When ordered by the Government to inspect points in the South as a yellow fever expert, I have assumed it to be my duty, not solely to report upon the diagnosis of individual cases, but to form an opinion as to the actual state of the outbreak, whether it be possible to localize it and stamp it out; or, on the other hand, whether the outbreak is beyond the control of our means of sanitation. I have even deemed it possible, when yellow fever was not found in one of the Southern States, to predict whether it was likely to break out or not during the summer. The diagnosis, then, from my point of view, is of two kinds, namely, as to the epidemic status of the locality, and as to the individual cases.

A careful study of the conditions existing in Cuba during the earlier part of the present summer made it very probable that yellow fever would extend from that island to this country. There probably has never been so much yellow fever in Cuba as there has been during the present season.

DETERMINATION OF EPIDEMIC STATUS.

First, as to the epidemic status: There are several features characteristic of the community where yellow fever is prevailing that make the fact known to an experienced observer, even when willfully or otherwise its presence is denied by the physicians and local authorities. Without seeing a single case of the disease I have often made up my mind as to the existence of yellow fever from the reports of prevailing sickness given by the physicians.

In the first place, many cases of acute febrile attacks of mild character are reported and an attempt is made to show why they can not be cases of yellow fever. They are usually ascribed to an epidemic of dengue or to a prevailing malarial infection. The report that some of these cases have shown albumin in the urine becomes extremely suspicious. Fatal cases are reported, but some intercurrent disease or previously existing condition is supposed to be the cause of the fatal termination. On investigation it is found that most of these cases are of young people. Very often one or two physicians are found in a locality who positively declare that they have seen extremely suspicious cases or positively diagnosed such cases yellow fever. These physicians are generally younger members of the profession who have never seen the disease. It is a matter of experience that usually the older physicians acquainted with the disease in former epidemics fail to recognize these early cases and are the last to become convinced of the existence of the disease.

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*Acting assistant surgeon Marine-Hospital Service during the yellow fever epidemic of 1897.

Convalescents from yellow fever may be discovered also on the streets. An icteroid hue of the eye persists usually for some time after recovery, and I believe not rarely shows itself also as a premonitory symptom of an attack.

Another aid toward forming an opinion is found in the study of the mortuary records. A comparison should be made between the present time and the preceding year. Sometimes this investigation is in itself enough to give strong presumptive evidence one way or the other. The characteristic feature of the mortuary records is the increase in the number of deaths among the white population. The class of the white population especially affected varies according to the manner of introduction of the disease. It may affect especially the sailors, or children, or railroad people. Even when there is no marked increase of the death rate of white people we may find causes of death that are suspicious. For instance, young adults dying of congestion of the stomach, congestion of the brain, purpura hemorrhagica, meningitis, Bright's disease, bilious remittent fevers.

DIAGNOSIS OF INDIVIDUAL CASES.

The diagnosis of individual cases of yellow fever is, in my opinion, very easy. There is no acute febrile disease in which there are as many signs that may be called pathognomonic. The diagnosis of the disease rests upon three such symptoms; namely, the facies, the albuminuria, and the want of correlation between the pulse and temperature. I rely mainly for my diagnosis upon the facies, which I consider extremely characteristic. However, as I consider it my duty to convince the local practitioners of the existence of the disease, I make it a rule not to announce officially the existence of yellow fever until I have been able to show the presence of albumin in the urine. My own mind, however, is generally made up by the simple inspection of the patient, and I almost invariably find my opinion confirmed on the second, third, or fourth day by the appearance of the albuminuria.

FACIAL APPEARANCES.

The appearance of the face is that of typhus fever during the first forty-eight hours of this disease or like that of measles before the eruption breaks out, with a more or less pronounced icteroid hue. It is the latter feature, I believe, which gives the face its characteristic appearance. In the first twenty-four or forty-eight hours it is by no means a distinct jaundice. The physician to whom I am showing the signs of the disease usually expresses surprise when I state that jaundice is present. It is, of course, best noted in the sclerotics. It is hidden, however, by the marked injection of the smaller vessels. The icteroid hue is often better seen at some distance from the patient than when the eye is closely inspected. It seems to show itself in waves with the different movements of the eye. Possibly this is the result of transient contraction of the vessels of the conjunctiva or of the different angles of reflection of the light upon the eyeball. In severe cases, and on the second and third day of the disease, the jaundice becomes more prominent. It will show itself in distinct waves as the capillaries of the skin contract with the movements of the facial muscles or it may be brought out by taking up a fold of the skin between the fingers, when the contrast between the yellowish, anæmic skin and the surrounding congested areas will become well marked. Later on there may be well-marked jaundice. By this time usually the florid color of the face has been replaced by a more dusky hue. In the later stages of the disease there are also characteristic features of the facies in grave cases. The mind is usually clear, and there is a peculiar alertness and watchfulness that is not seen in other acute febrile diseases. The physicians who have not seen yellow fever for many years seem to have this peculiar phase of the later stages of yellow fever impressed upon their minds. This, however, is too late a diagnostic sign for my purposes, and besides it does not appear in mild cases of disease.

ALBUMIN.

The albumin appears in the urine usually on the third or fourth day of the desease. It may be very transient albuminuria. In many mild cases the albumin is present only in the urine passed in the evening of the third or fourth day. In many cases it is only a trace, but even then by a careful centrifugation granular casts may be found in the urine. In severe cases the quantity of albumin may be very great and the different forms of casts characteristic of acute parenchymatous nephritis are found in abundance in the urine. Now, there are many acute febrile diseases in which albumin may be found in the urine, but in none of them so constantly nor so early when in connection with such mild manifestation of the toxæmia. In all such diseases the albuminuria will be found at the end of the first week or during the second week, and as an evidence of persistent high temperature and intense toxæmia. Cases of yellow fever corresponding in intensity with these present at the same time such characteristic features, that it is impossible to mistake them. The difficulty of diagnosis can only be met with in connection with mild cases.

PULSE AND TEMPERATURE.

The third characteristic symptom of this disease is the want of correlation between the pulse and the temperature. This may be a rather late manifestation and may be absent, especially in children. It should be remembered that the characteristic feature of yellow fever in this connection is not a slow pulse during the convalescence or even during the defervescence of the fever. The characteristic features is that quite often we find that at the same time that the temperature may be rising the pulse will be falling. On the third or the fourth day of the disease, for instance, with an evening exacerbation of half a degree or 1° of temperature, we may find that the pulse is perhaps 10 beats slower than in the morning. I have seen, however, the same discrepancy in cases of true dengue, and in the Tropics also, in connection with other febrile diseases. Still, this is exceptional. In dengue the excessive fall of the pulse presents itself with a distinct defervescence of the temperature, and I suspect that many cases that are reported from Cuba of slow pulse in typhoid and malarial fevers may have been cases of yellow fever.

USE OF THE MICROSCOPE.

An erroneous belief has prevailed throughout the South, especially among physicians who were not practical microscopists, that the microscope should be an important aid in the diagnosis of yellow fever. It appears that poorly prepared abstracts from the work of Sanarelli have led many to believe that a characteristic feature; the bacillus of Sanarelli itself, was found on examination of the blood. Now the truth is, that even with the assistance of post-mortem examinations, Sanarelli was able to discover his bacillus in 56 per cent only of the cases of yellow fever. He would be a poor clinician, indeed, who could only diagnose about one half of the cases. The truth is, however, that during life the microscope could not establish a positive diagnosis. As far as our present methods go, it would be impossible to distinguish between a drop of yellow-fever blood and blood from a healthy man.

Negative evidence may be presented by the microscope. The presence of the plasmodium malariæ, for instance, would prove that a case was suffering with malarial poisoning, and presumably not with yellow fever. But the differential diagnosis between these two diseases is usually easy. The bilious remittent fever, that in our old text-books of medicine occupied a conspicuous place in tables of differential diagnosis with yellow fever, has practically disappeared from the Southern sea border since yellow fever ceased to be an endemic there. It was, in fact, the yellow fever of the natives and of places in the interior. The former were supposed to possess in a certain degree immunity against yellow fever, and the disease was believed to be restricted almost to the littoral.

The plasmodium has been found in the blood in cases of yellow fever.

The mistake made by the board of experts of New Orleans, when they failed to recognize the existence of yellow fever at Ocean Springs, was due to the finding of the plasmodium in at least two of the cases.

DENGUE AND YELLOW FEVER.

The prevalence of a widespread, mild, epidemic fever during the present outbreak of yellow fever has been undoubtedly a source of doubts and difficulties in connection with the diagnosis.

Many of these cases were found to exist in houses where cases of yellow fever were present at the time, and I must confess that it was impossible to discover in them any of the characteristic symptoms of yellow fever. Many of these cases had a distinct eruption and must be looked upon as cases of dengue. This fact may bring forward new problems as to the relations between these two diseases. From our present point of view, we can only state that yellow fever appears to spread more easily when there is an epidemic of dengue prevailing. All evidence goes to show that a previous attack of dengue does not protect against yellow fever, and we must look upon the former as an entirely distinct disease.

IMPORTANCE OF DIAGNOSIS OF FIRST CASE.

I can not insist too much upon the importance of the diagnosis of the first case of yellow fever in a locality. Undoubtedly the cause of the epidemic of yellow fever is to be found in the introduction into a community of cases that are not suspected to be yellow fever. This probably occurs most frequently in connection with individuals of the colored race. The disease in them is usually very mild, and their movements from place to place are less likely to attract the attention of the health authorities. I have no hesitation in saying that if the first case of yellow fever introduced into a city were always recognized, the spreading of the disease would be invariably prevented.

I will conclude this report by inviting your attention to the fact that the movements of the yellow-fever expert have been frequently interfered with by the fears of the communities that he might convey the disease from place to place. In moving from one locality to another I took all the necessary precautions and felt absolutely sure that I could not be a source of infection. I was immune and traveled with very little baggage, which I frequently changed. Yellow fever has never been carried from one locality to another in this manner.

This fear of the communities was in part genuine and due to ignorance, but was also in part a pretended fear of those who knew better. I have finally to state that I have received every attention and assistance from the local health authorities in all the cities that I have visited.

TREATMENT OF YELLOW FEVER.

By Surg. R. D. MURRAY.

I have seen yellow fever in twenty-one summers (including 1870) and in every month except February. The elimination of yellow fever from our nomenclature will follow when there is a proper conception of the influence of clothing, bedding, and unclean bedrooms as transmitters. The disease is air borne for some distance; the infection is stronger at times and places than at others; whether it is intensity or quantity I do not know; it may be diluted, and is transmitted by clothing, bedding, and related articles. Hair from the dead has transmitted it; corn sacks, blankets, and old newspapers have carried it; mountains of filth will not produce it; they may give it a new nidus or garden from which it goes out "seeking whom it may devour." The cleanest town in the South may have a severe prevalence if the people insist on disobeying the advice of the health officials.

Certain ideas as to pathology.

In 1875, as a result of several post-mortems and an attack of the disease, I came to the conclusion that yellow fever was an inflammation of the duodenum, primarily, and wanted to call it epidemic duodenitis. Many post-mortem examinations have since convinced me that the primary lesion is in the duodenum, and I insist that the mildest cases have a lesion in the organ referred to that can be demonstrated, if due care is taken. The same after-death examinations, as well as bed side experience, have shown me that the death-dealing process was not the "inflammation" that I was taught thirty years ago to understand as inflammation, i. e., there is no proliferation of cells or tissue and no new growth.

Duodenal origin.

There is a primary involvement of the duodenum and the symptoms of the disease follow generally in regular order. The mildest cases have a tender duodenum (if you know how to press) and a *little* back ache; note how close

Stools to be examined.

to the spinal column the duodenum lies. If the stools could be *all* and carefully examined sometime a mass of white mucus with a black or brownish middle will be found. Maybe there will be a stool of black mucus once only. It is fair to say that there is always a clay or bismuth stool with the mucus clot stained with black. The "*bloody sweat*" from the duodenum, and in bad cases from upper intestines and stomach, starts in the duodenum.

Fulminant cases.

Sometimes the symptoms come in such quick succession that we think the attack is necessarily fatal. Many times in such cases we have no chance to ask the patient how matters fared with him twenty-four or thirty-six hours before, when he was sick, but would not admit the fact. Walking cases are as common in this as in the other bed diseases. I have known a man, suffering with headache for three days on duty, to vomit black on the stairs on the way to his deathbed. I have given immune certificates to persons who never went to bed.

Choice of a physician.

Psychological effects.

In ordinary, the patient should like the medical attendant. If the physician is distrusted, he should be called off or feign illness, so that a favored one can be called in. Consultations over the patient are injurious. I would have the doctor do his share in keeping up courage, hope, and life-purpose in his patient; to minimize the aches, distress, and fears, and to carry his patient's mind away from the *now* with its dreads to *to-morrow*, with its reward or revenges. Several people are living now because, in their desire to take vengeance on me for what they thought was my indifference, they forgot themselves and their conditions.

NOT EVERY CASE NEEDS TREATMENT.

Mild cases

It is fair to say that of one hundred cases seventy-five need only to be let alone by the extra-attentive nurse or friend and heroic physician. They will get well under any plan of treatment and under miserable local conditions; notably so with infants, who, if they die, are generally sacrificed by curds or some acrid medication.

These seventy-five are "cases" and should be recorded, but only for sake of good records and to establish their immunity. They should receive only what occasion demands and be watched for untoward incidents.

Of the twenty-five some will need formal attention and careful procedure; others will die in spite of all reasonable aid. Some vicious habit or chronic disease will add to the trouble, and in some cases uncontrollable fear will insure a fatal result.

Age limits.

My oldest patient to get well was 109 years of age; the

Chronic diseases and habits as factors.

Yellow fever a frank disease.

Cheapness of treatment.

youngest was 52 hours old when she threw up black vomit. One of my children had black vomiting five days after she was born. I know of the recovery of a chronic Bright's disease sufferer; of a morphiomaniac's recovery, and last summer gave a diabetic doctor such cheerful council that he had a severe attack without fatal result, and has been in better health since than before. I cite these cases to show the triviality of the disease if "taken right and in time." I have often said "Yellow fever is the most honest, most trivial, and cheapest to treat of all diseases that kill." It is "honest" because it comes with definite signs and leaves no trace, always insuring the afflicted one that he is hereafter immune; it kills, if at all, in a few days, and is merciful in the killing, as the doomed one is usually conscious to the last and does not linger as a consumptive or one afflicted with cancer; "trivial" because 50 per cent of those who suffer with it are scarcely aware of serious illness, and have no sequels to make them miserable the remainder of their lives; also, because it rarely takes off children, and they, by reason of the attack, gain the privilege of living in its habitat; "cheapest to treat" because it is so; the delicacies, liquors, etc., sometimes provided are generally consumed by the disbursers and attendants and are not fairly chargeable to the sick; the medicine actually needed costs very little.

TREATMENT OF YELLOW FEVER.

Initial signs calling for prompt treatment.

When called to a man (most of my work has been with men) who has had a chill some time during the previous night, has a pulse of 100 to 112, with temperature of 101.5° to 103°, headache (*cutting* across the forehead), backache running down into the thighs, *sore* muscles, skin hot if you hold your hand on it a while (hands and wrist not hot to gentle touch), anorexia, white tongue (may be a yellow center far back—the red edges and red diamond on tip will not show at once), suffused eyes, and notably or faintly purpled cheek bones with semipuffed upper lip, the hundred chances are you have a case of yellow fever.*

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* Yellow fever usually begins at night when the person is in bed and in a relaxed condition; malarial fever usually attacks when the person is at work. Regardless of books, I reasoned this point out as a diagnostic fact over twenty years ago, and am flattered that others discovered it too. Night watchmen have sickened in daytime. A restless early morning in bed with little desire for breakfast is a frequent history; everything eaten as breakfast does harm in such cases. Dengue pains are worst *in* joints—yellow fever soreness is between the joints. As malaria coincidents there is no rule for differentiation excepting *perhaps* the attack in bed or at work.

Initial purge necessary.

Carry purgatives in your pocket.

Don't let the patient know he is very ill.

Give three or four compound cathartic pills at once and as soon as possible give a hot foot bath (an all-over bath is better, but is not always possible), with or without mustard and salt. Mustard at this time is really a nonessential, but sometimes the patient thinks it is the proper thing; so with the table salt. As to the cathartic: calomel at first is too slow and usually must be sent for, the pills contain enough of it and *are* in your vest pocket. Every yellow fever doctor should carry first doses of compound cathartic pills, compound acetanilide tablets, and such other pocket remedies as may be needed on emergency. A parade of a small medicine chest is not advised. Do not begin to make a reputation for wonderful medical skill now. Dwell on the dengue symptoms and the signs of malaria, and without great formality convince the patient that "it is not yellow," but do not say so. Keep back information about the actual temperature all the way through, but tell them about the height of the fever. No patient should ever hear that his fever went above 102° until after he gets well. (I saved a doctor once by hiding his thermometer and using my French scale, which he could not translate.)

Coal-tar derivatives.

Disposal of changed clothing.

Give as soon as convenient, or, if fever is above 102°, at once, any coal-tar derivative in 7½-grain doses, with some bicarbonate of soda and caffeine. The antikamnia compound is a good one. If powders or tablets are objectionable to the patient, give antipyrine. I nearly always use acetanilide with soda and caffeine. Have no objection to any, except that I like cheapness and simplicity. After the bath and a good sweating, under blankets, for from four to six hours, rub dry and cover with two blankets. (The clothing should have been hung outside of the house or dumped into a tub of water; dispose of the wet sheets and blankets in like manner. When washed they are ready for use again; this hint in regard to prevention of infection.)

If a person likes blankets next the skin, so much the better for prevention of skin shock. Quilts and counterpanes are objectionable because of the nasty odors they retain.

Drinks.

Repeat the coal tar derivative every three to six hours if fever keeps above 102°; give for effect and not pro forma. Have the face and hands wiped frequently, give orange-leaf tea, Apollinaris water, lemon-grass tea, hot lemonade, ginger ale, *small sips* of ice water, and other drinks ad libitum, but not ad nauseam. Always start with the quantity you are willing the patient should have, and let him drain the cup; this particularly in the case of water. Try to supply fluid for the three or four days' sweating that will be kept up. Apollinaris is good on account of the common salt it contains; for some reason common salt is a good thing to give and has been grossly neglected. Passed Assistant Surgeon Smith, on duty at Ship Island last year, used it, methodically, about a drachm a day, with excellent results. I have always given much salt in the food, but never gave it dry. No spirits of any combination should be even thought of for the patient.

Common salt.

The first bowel actions should be had sitting up for the first thirty-six hours or so for physical reasons—and for mental reasons, too. If the bowels are not freely and comfortably relieved within six hours, give a small saline, and let the patient choose the kind. Castor oil is the best thing to give, but many so bitterly object to it that it is not advisable in all cases. Sulphate of soda is the next best. As a rule, the magnesias cause griping and flatulence. Seidlitz powders are good, but cause some gassiness and uneasiness—however, the patient should have his choice, as he feels bad at this time and an insistence on *one* thing magnifies his dangers, in his own mind. Sometimes an extra pill will do the hoped-for duty. I do not object to sirup of figs, castoria, or other cathartics—only want results. If nausea is present an enema is in order.

Bowels to be kept open.

DIET (OR LACK OF IT) A MATTER OF FIRST IMPORTANCE.

Do not *deny* food but give the milklike water of long-boiled hominy or corn meal, salted and strained through cheese cloth. Keep the pot boiling all the time! Rice water is good. Sago is better, as it is slightly aromatic, but my experience has been with the poor. Mexican atole is excellent—made from crushed lye-hominy. Sometimes it is well to *flavor* with a bit of meat juice. Chicken soup, with rice, so thin as to be equal to starch water, is not to be tabooed. The point is to give no food for four or five days, but to *appear* to give food regularly. Often you must promise food and abuse the nurse in the presence of the patient for the nonfulfillment of your orders, and then apologize to the nurse outside.

Diet

If the first form of antipyretic tires the patient, or seems to him to do no good, change the form; here lactophenin or amonol or antipyrine will serve as substitutes; may be capsules of the same as you were giving will accomplish the object sought. Do not forget the bicarbonate of soda and caffeine. Remember always that the *patient* is sick; not the doctor.

Antipyretics.

Conjoint infection malaria and yellow fever.

Here I must advise you to carefully consider the question of malaria, for the Laveran organisms can do their work while the yellow-fever germ is also active. In a malarial region it is advisable to give from 40 to 60 grains of a cinchona salt in the first twelve or twenty-four hours, in order to ward off or forefend a malarial chill which may occur during the period that should be yellow-fever convalescence. I lost two patients with *malaria* when they were convalescing from yellow fever twenty years ago. In nonmalarious regions, or on shipboard, no routine is necessary, but in Mobile, New Orleans, Scranton, or in the back country, care must be exercised. The preliminary cinchonidia or quinine may be given with the compound cathartic pills, and it is believed that early cinchona aids in producing calm in or to the patient. Do not give all at once, and do not expect the cinchona salt to act instead of the coal tar products. Give them together, or nearly so.

High enemata.

After thirty-six hours or so give an enema every day and try to have a bed pan used. It is impossible for many to use a bed pan; then have the patient helped up on a vessel or commode. Instruct the attendant that the patient must be *helped*, and not use his own strength. The patient's own muscular force must be saved somehow. If the expected action does not occur, give another enema with a long tube. A short catheter of 30 or 32 caliber should be in every yellow-fever doctor's pocket, which, attached to an ordinary self-injecting syringe, makes a "long tube." I and many others have saved lives by use of a large catheter. The catheter may be washed and used again. Do not fear infection.

Enemas may be made quickest with soapsuds and molasses; ordinarily soapsuds will suffice, later on not too strong. Consider the stools, and if they are not sufficient in quantity, and you have reason to believe there is a fæcal matter *high up*, think of giving a dose of castor oil 2 drachms and olive (not lard) oil, 6 drachms, more or less as occasion seems to demand. Lemon juice is the best vehicle for the oil. Perhaps it will be better to tell the attendant to give the potion as if you knew nothing about it. Patients like to circumvent the doctor! I believe that small doses of castor oil and large doses of sweet oil will not produce the frequent contractions of the colon and the common intussusceptions of the small intestines that are found post mortem. Constant peristalsis *downward* is necessary; harsh purgation is to be avoided. This remark does not refer to the primary emptying of the bowel, but

Oil catharsis.

to repeated emptying efforts by calomel or pills or salts to insure a daily bowel movement. Olive oil does not cause the bowel strictures that I dread—I think small doses of castor oil will not. I prefer to mix them, and have saved many lives by this plan.

For nausea

Cocaine.

Keep surroundings clean and sweet.

Massages.

For nausea use ice about the head, face, and neck. A piece of ice, wrapped in a cloth, rubbed rapidly about the lips, temples, and neck will keep down almost any offensive dose. If the nurse can not do it effectively or does it rudely do it yourself. Give cocaine in one-fourth grain tablets *floated* down the throat, repeating as required: solutions do not accomplish the object as well, and as the patients are human beings they might get poisoned. Dr. Thorington, of Colon, introduced cocaine as a remedy in yellow-fever nausea in doses of 2 to 3 grains in solution. I think I first insisted on *small* doses in tablet form floated into the stomach where it is needed. Bathing the face with vinegar frequently is excellent in subduing nausea. *Eau sedatif* is praiseworthy for the vinegar it contains. Elegant toilet waters are pleasing to all and possible to some. Mustard to the epigastrium is always to be resorted to, but avoid sickening the patient by putting the pungent mass too close to his nose. Look to the covering, the pillow, the mattress, the commode, the nurse's breath, or other condition as a cause of nausea. A fresh sheet or pillow case or pillow sometimes makes a "lot of difference" in the matter of comfort. Do not forget the bowel peristalsis; the "duodenal bloody sweat" may be trying to get *up* through the pylorus and maybe an enema from a long tube is now essential to produce quiet. To relieve restlessness and the aches and "tired feeling" it is well to briskly rub the legs and back with a coarse towel under the cover every three to six hours. Massage through the cover is sometimes grateful.

Albuminuria.

Turpentine as a remedy.

After sixty hours, in ordinary, examine the urine. If albumen appears as a *trace* give more fluids. If the quantity increases to from 5 to 20 per cent give turpentine in 7 or 10 drop doses every four hours. For 5 per cent albumen nothing but more fluid is necessary; if it increases to 75 per cent give more turpentine. Rub the chest and back with turpentine, not so much for absorption, but so as to put your charge in a turpentine atmosphere, to prevent him from smelling and tasting the medicine. Do not let the patient know you have examined or want to examine the urine; have portions saved without his knowledge. It is amazing what quantities of turpentine can be taken without harm. There is no danger of strangury. I have given half, sometimes a teaspoonful, to children where there was suppression, and generally with good effect.

But it is not advisable to give all that may be considered necessary in a case at one dose. Turpentine is a diffusible stimulant and a good styptic; it is laxative also. I have never seen a particle of benefit follow administration of digitalis. Large enemas of water about the temperature of the air, or cooler, placed high up, do much good if they are retained. Please note that the kidneys are not inflamed, but rather paralyzed.

Cool enemata.

Sulfonal for insomnia.

For sleeplessness after second night give sulfonal in 15 to 30 grain doses, and repeat if necessary in three or four hours. Bromide and chloral are good, but are often borne badly. I used trional once with good result. Ofttimes sleeplessness is due to the odor from a dirty quilt or pillow; sometimes to a lumpy mattress. These may seem trivial, but it is a doctor's business to look out for his patient.

Good beds.

In some cases a woolen shirt—a sweater—is necessary, as in restless children and persons who will not keep the arms under cover.

Diet in convalescence.

As the fever subsides diminish the remedies and increase the food, but it is generally unsafe to give anything like milk or eggs before the fifth or sixth day. Your patient will not starve to death, but if he is fretted by a great lot of rules or unpleasant attendance and surroundings he may not get well.

COLLAPSE.

Treatment of collapse.

Collapse is a horror. Generally an enema with a little whisky and turpentine, given with a long tube, will do good. Hypodermatic strychnia, brisk rubbing of arms and legs and back with mustard is to be adopted. It is always necessary to procure an action from the pylorus downward. If this is not done there will soon be black vomit. A deft administration of olive oil—1 to 3 ounces—is a life saver. Collapse is usually caused by an influence equivalent to surgical shock, and the organs through which the shock comes are in order of frequency—the stomach, from excess of, or because of faulty, food; the skin, from chilling by getting up or getting uncovered; the brain, from hearing bad or unwelcome news. To avoid collapse it is needful to prevent any shock to the organs mentioned. Whatever the origin of the collapse, the treatment is the same, but in case of mental disturbance some abusive or consoling talk, as the case requires, must be indulged in also. More people have died in consequence of too early or impru-

Canse and prevention of collapse.

dent feeding than is generally supposed. I have saved a life by insisting on having a window shut down to prevent the entrance of "the lovely breeze." Free ventilation has caused the death of many; so has the sleepy nurse who let the rolling patient get naked in the chilly hours of the early morning; so has the gossipy neighbor who consoled the convalescent by telling him of the death of a friend or of the outbreak of fever in the town to which the patient's family has fled. There is another *source* of collapse. During early convalescence there is an excessive venereal desire, and under such circumstances conscience is much dulled or dead. It is necessary to warn the partner who is not sick or arrange that man and wife shall not be left alone until convalescence is complete. Thus nurses of the opposite sex are to be doubted and tabooed, if possible.

Cause and prevention of collapse.

I am confident that collapse, whatever its apparent cause, is generally accompanied with an obstruction in the small intestine and oftener in the upper part. I would like to say that the shock caused the obstruction. Sometimes it is food—then high up; sometimes it is an intussusception—then lower down; sometimes it is due to a contracted colon, but if the patient could have been permitted to lie in quiet there might have been continued peristalsis. There are some who dispute my *mechanical* theories and the effects of mental conditions.

SECONDARY FEVER

Ptomaines.

The secondary fever (that of after five days) is a ptomaine poisoning and needs some modifications of the routine. Give antipyretics and high clysters for effect and increase the food. Ice to the head and rubbed down the spine, every half hour rolling the patient from side to side, will do good. Alcohol will do much good at this stage; the patient's choice is the form to use; brandy is the worst form, as it produces hiccough. Dry catawba has served me well. Gin is the best form, as it may assist the kidneys. I have never seen any benefit to follow champagne; ginger ale is better.

Stimulants.

Turpentine.

Continue the turpentine if the albumen compels it. I think guaiacol rubbed into the skin of the abdomen would be beneficial, but I never had a chance to try it; if put in the stomach, it is liable to cause nausea and eructations.

Opium increases albumen in urine.

Chronic vomiting after four or five days may be relieved by cocaine or one-tenth grain doses of calomel with 1 grain soda bicarbonate frequently repeated. One-twelfth grain doses of morphia hypodermically do a lot of good; watch the urine, for opium increases the albumen or the chances of it. Small blisters over the stomach do good service. Sometimes bismuth serves a good purpose; peppermint and soda have served well, but it is necessary to compel a through and through action of the bowels.

Avoid milk; use starches.

For five days give no food but thin starches. Milk kills, as does every sort of food that requires stomach digestion. Limewater alone sometimes gives comfort to the stomach, but mixed with milk it often causes the milk to stay in the stomach to become curds in the half-rotten duodenum. Patent and predigested foods are all right in the ptomaine fever and recuperating stages, but hurtful for first four or five days; so with opium and alcohol.

At Flomaton, last summer, over eighty patients were treated with catharsis, tincture aconite, and Warburg pills. They were fed ad libitum on ice cream. Over a hundred gallons of ice cream were used. There were four deaths among the number treated.

There are other unique and unusual forms of treatment which I could describe, but as I began to tell how to care for *worst* cases I will omit them for the present.

Moral therapy.

The physician should remember always that the senses of the yellow fever patient are as acute as those of a puerperal fever patient and that all necessary subterfuges must appear to be absolute truth. I know of many deaths due to actual truth—brain shock and collapse following. There is no febrile disease in which physic and the mind play such prominent rôles. A constipated patient or one who has a dreadful fear of the fever will, as a rule, not recover.

THE PHYSICIAN'S DUTY TO PATIENTS.

Be confident and cheerful.

Primarily it is a physician's duty to be (or appear to be) frank, nonchalant, observant, cheerful, confident, hopeful, and positive; he must convince the patient by word or manner that he for one among the numerous sick is *not* suffering with the "prevailing" fever and is not very sick. Except in disputed cases, a half dozen questions will elicit all the information needful for detailed action for next twenty-four hours. As patients later in the disease are all-embracing in acuteness of senses, it is necessary to be frank (not truthful) and to remember and adhere to whatever has been said before. Many a life has been lost by ill advised sympathy, too much nursing and attention, too frequent dosing, and senseless gossip.

NURSES AND THEIR FUNCTIONS.

Nurses to obey orders.

The more ignorant, if obedient, the nurses the better. All the professional nurses I have seen are at odds with the doctor and continually strive to convince the patient that when all fails *he* will bring order out of chaos and *presto* the patient will be cured. The nurse should have only sense enough to obey orders. Dumb nurses would be ideal in all critical or extra critical cases. The doctor should know how to direct the nurse as to his duties and to emergencies and crises and should be careful so that no disputes arise. The sick person must depend on nurse as well as doctor. I know of too many preventable, but not prevented, deaths due to strife between physician and nurse; unfortunately in some instances the doctor was to blame in being careless in giving directions. I know of some cases sacrificed to the zeal of a nurse who "knew more than all the doctors."

FIRST AID TO SUSPICIOUS CASES.

In the Brownsville epidemic I was compelled by the geography of the country to include within the cordon a small region inhabited by nonimmunes. If I had acted in accordance with the law of Texas then in force, I would have exposed many more people nd had an area to care for nearly as big as Rhode Island. To protect the people outside the infected town and inside of the guard line I supplied my guards and patrols with the medicines then in use, i. e., compound cathartic pills, mustard, and quinine pills, and gave directions for their use. Nearly a hundred cases were treated by the guards, in the country, without a death. Since then I have advised interested persons to provide the pills, mustard, and acetanilid in advance. If I were to outfit a guard line now I would furnish compound cathartic pills, compound acetanilid tablets, and mustard, to be used while the doctor was being sent for. I have suggested to Major O'Reilley, of the Army Medical Corps, that the pills and tablets be added to the first-aid package of the troops who go into yellow fever regions, with instructions for a man to take a pill at bedtime if his bowels were not freed during the past day; to take more if he had a chill in the night, and to take a tablet if he suffered with headache. It takes time to get a physician, and I feel confident that if men are given .. little instruction and the few necessary remedies there will be less suffering and perhaps less mortality. It is well known to Southern physicians that a dose of compound cathartic pills will often stop a malarial attack, particularly in negroes, and it is believed that the use of the coal tar derivatives has lessened the necessity for cinchona in the treatment of malarial diseases.

I have tried to tell how to treat the yellow fever with a limited number of remedies. Any person who will carefully follow directions will succeed in keeping the death rate at about 4 per cent, and counting accidents, ages, habits, and conditions, that is enough to hope for.

THERAPEUTIC TREATMENT OF YELLOW FEVER.

By P. A. Surg. H. D. Geddings.

[From Annual Report of Marine-Hospital Service, 1894.]

General consideration.

In discussing the therapeutic treatment of yellow fever, it is not proposed, indeed it is impossible, to here present any long array of cases, with records of temperature and pulse and detailed symptoms of each particular case. It shall be my endeavor to present nothing that has not been of real value in the hands of my colleagues or myself, and anyone taking the trouble to read this and not finding any particular line of treatment laid down will please bear in mind that this is a record, not of what might have been, but of what has been, done. The writer believes that the treatment of yellow fever, like that of other acute specific febrile diseases, should be symptomatic and directed toward meeting plain and specific indications. The symptoms may be divided, for convenience, into those (*a*) belonging to the onset of the disease and those (*b*) which arise during the course of the illness.

TREATMENT OF INITIAL STAGE.

Under the first head may be included the chill and subsequent fever, the distressing headache and pain in the back, loins, and limbs. For the relief of these, as well as for properly initiating a systematic treatment, it is believed that the old plan of administering a hot footbath containing mustard is an eminently proper one. The bath hastens reaction from the chill, markedly relieves the headache and pains in the back and legs, promotes diaphoresis, in this way accomplishing good, and being perfectly incapable of doing any harm. The patient, being then restored to bed, should be covered warmly but not too heavily, and gradually uncovered as diaphoresis proceeds, in order that too great prostration should not ensue. Care of course

Baths.

Purgation.

should be exercised to prevent sudden chilling of the surface. As soon as the patient is made comfortable in bed the remedial treatment should be begun. At this stage this should consist of a sharp purge, preferably mercurial. I have found calomel 0.33 grams, compound powder jalap 0.66 grams, administered in capsules, most efficient. Others prefer the compound cathartic pills (U. S. P.), of which one, two, or three may be administered, according to the age and general condition of the patient. Should either of these remedies fail to move the bowels freely within six or eight hours it may be followed by a moderate dose of castor oil, a seidlitz powder, or a bottle of citrate of magnesia.

TREATMENT OF FEBRILE AND NERVOUS CONDITIONS.

Use of coal-tar products.

Closely following the first purgative should be administered one of the coal-tar febrifuges, phenacetin 0.50 grams, or antipyrin or antifebrin 0.66 grams, either of which may with advantage be combined with 0.12 grams to 0.18 grams of citrate of caffeine. It will be well to discuss here the effect of the coal-tar series of febrifuges in yellow fever. Possessing as they do analgesic properties of the highest order, being second in this respect only to preparations of opium, in addition to their well-known power of reducing temperatures, they fill a most important place in the treatment of yellow fever. By their use in moderate doses at the inception of the attack we relieve headache and the racking pain in back and limbs, diminish restlessness, and reduce temperature within twelve hours to a point, not normal, but considerably below that at which it stood when reaction from the chill had fully taken place. Indeed, it has seemed to me that the action of the first dose of the antipyretic furnished, in some sort, an index of the course of the particular case under observation. Given a case in which after the administration of the antipyretic the patient passes into an easy sleep and wakes with diminished headache and other pains, a moist skin, and a reduced temperture, I feel encouraged to hope, though I do not say that the case will be mild or of moderate severity and will end in recovery. Given, on the contrary, a case in which the antipyretic produces but slight influence on the temperature, where restlessness is not diminished or controlled, where pain persists, and the skin, though moist, has a burning, pungent feeling, I fear the worst and expect trouble to the very end. Repeated doses of the antipyretic are not needed, or indeed indicated. It is my belief that one, two, or at most three, doses in the first twenty-four hours of the disease will accomplish all that is to be gained from this series of remedies. Administered later in the disease, they exercise too depressing an effect on a heart already weakened as a consequence of a toxæmia more or less profound.

TREATMENT OF GASTRIC SYMPTOMS.

The gastric irritability, which is often extreme at the onset of an attack of yellow fever, may be controlled by sinapisms to the epigastrium, abstention from fluids, and frequent ingestion of small pieces of ice, which not only allay thirst, but also tend in themselves to relieve nausea. Should nausea or vomiting persist, the administration of cocaine hydrochlorate, in doses of 0.015 gram to 0.030 gram every hour or two, will often act almost magically. Small quantities of carbonated beverages, as vichy, seltzer, or appollinaris water, ginger ale, or very dry champagne, administered ice cold, will often prove of service. Creosote has also been highly recommended, and also a mixture containing hydrocyanic acid and morphia. Considerable relief is also derived from the application to the epigastrium of a liniment composed of olive oil and menthol.

Cocaine

Carbonated beverages.

IMPORTANCE OF RENAL SYMPTOMS.

On the afternoon of the second or morning of the third day the presence of albumen in the urine may be noted, unless the case be of the most ephemeral mildness. I believe that no case of yellow fever can occur without presenting albuminuria at some time, though that time be limited to a few hours, perhaps. It is argued by some that as cases do occur presenting a quantity only recognizable by chemical tests of great delicacy, it is possible that some occur without any. On the other hand, it is argued that a disease so terrible when severe must give some sign, even when very mild. The quantity present on first detection, and its increase or diminution from day to day, form, perhaps, a fairly good guide to prognosis. If it appears, increases gradually, and then begins to diminish, prognosis is good. If, on the contrary, it appears at first in large amount, persists or increases abruptly, trouble may be anticipated.

Albuminuria.

Significance of.

"BLACK VOMIT."

The two gravest symptons that can arise during the course of a case of yellow fever are undoubtedly black

Causes. vomit and suppression of urine. Black vomit is caused by rupture of walls of capillaries or venous and arterial radicles, and the discharge of blood into the cavity of the stomach, where, coming into contact with hyperacid gastric juice, it becomes altered into small masses of brownish-black color, somewhat resembling coffee grounds in gross appearance. Its advent may also indicate a general hemorrhagic diathesis, which may be manifested by hemorrhages from the nose, gums, fauces, rectum, or by extravasations into the connective tissue of the scrotum. The abrupt appearance of black vomit in large quantities without warning is unusual. Characteristics of. Careful search will often show minute brown or black particles floating in clear fluid, and presenting the appearance described by some authors as "bee's or butterfly wings." It is not uncommon, however, that patients just before death should vomit a large quantity of black vomit, and that after death the stomach should be found to contain several quarts of the fluid. It would seem probable that in these cases the hemorrhage which produces it was more of an active hemorrhage than a capillary oozing, and that death comes quickly as the result of shock.

TREATMENT OF "BLACK VOMIT."

Treatment. How shall we best treat the condition resulting in black vomit? The problem being both to arrest vomiting and to treat the condition giving rise to it, it follows that treatment should be directed toward the general hemorrhagic diathesis. Probably the most efficient remedy is found in Perchloride of iron. the tincture of the perchloride of iron. That should be given in large doses, 1 to 2 c. c. every hour or two, or, if vomiting is frequent, after each act of emesis. Counter irritation to the epigastrium, the administration of stimulants, preferably champagne or good brandy administered Ice. in carbonated water and given cold, swallowing of ice, and Cocaine. administration of cocaine, make up about the sum of our remedial agents. While enough has been said to show that black vomit is a most serious symptom, it does not follow that every patient who vomits black matter will necessarily die. A fair proportion of cases recover after the symptom has manifested itself. Still, the ejection of black vomit makes a most profound mental impression on a patient, and for this reason has often hastened a fatal termination in a case which up to the appearance of this accident had done well.

TREATMENT OF RENAL SYMPTOMS.

Of far graver importance to my mind is the train of symptoms which leads to uræmia, and which are announced by partial or complete suppression of urine. I believe this to be the gravest accident that can happen in the course of yellow fever. The amount and character of the urinary secretion should be a matter of frequent inquiry in every case, grave or mild, from the inception to convalescence. A sudden and irregular increase in the amount of albumen should put us on our guard against possible urinary suppression, and prompt treatment should be instituted and maintained. Counterirritation over the region of the kidneys with turpentine or mustard, dry cups, the application of hot-water bags, all should be tried. A *tisane* of watermelon seeds has long enjoyed the reputation of being almost a specific among the Creole population of New Orleans, and I can bear personal testimony to its efficacy alone or given in combination with spirits of nitrous ether. Of almost equal reputation is a *tisane* of orange leaves, preferably of the bitter variety, given in large quantities and frequently. A remedy much used in Brunswick in 1893, and vaunted as almost specific by those very successful in the management of the disease, was spirits of turpentine, which was sometimes given in heroic quantity, as much as a teaspoonful at a dose and repeated. I can not speak of the remedy from personal experience, but the results claimed for it warrant its more extended use.

Counterirritation.

Tisane of orange leaves or watermelon seed.

TREATMENT OF BOWEL CONDITIONS.

Value of enemata.

A point in the treatment of yellow fever, with the importance of which I am much impressed, is the frequent washing out of the lower bowel with enemata of warm water and soap. Constipation is the rule in yellow fever, and no one who has noted the exceedingly fetid, almost putrid, character of the stools of a yellow-fever convalescent can fail to see the wisdom of removing the chances of septic absorption by frequent washing away of this fermenting mass. Pass a well-oiled rectal tube as far up into the bowel as possible, and with a fountain syringe elevated not more than a foot or two force slowly 2 or 3 pints of warm, soapy water into the bowel. The whole operation should be performed with the patient upon a bedpan, not seated upon a vessel or close stool. The effect upon the temperature and general condition of the patient is most marked.

USE OF ANTIMALARIAL REMEDIES.

As to the use of quinia or allied preparations in yellow fever, I concur in the generally accepted verdict that they are without specific effect. But as yellow fever almost always occurs in regions where malarial diseases are also rife, and as the intercurrence of a malarial paroxysm is one of the most disagreeable incidents that can mar the course of a case of yellow fever, I consider it good practice in such regions to administer 2 to 3 grams of quinine or cinchonidia in the first twenty-four hours, exhibiting the drug per rectum if the stomach is irritable.

Quinine
Cinchonidia.

DIETETIC MANAGEMENT.

A most important point in the management of yellow fever is the diet. Many a patient, his crisis past and the borders of convalescence reached, has been hurried into an untimely grave by the misplaced kindness of an apparently simple meal. The yellow fever patient should never be starved; on the contrary, he should be well nourished, but the most scrupulous care should be exercised in the selection and administration of his diet. "A little and that often" should be the rule. For the first few days milk with limewater given cold, then animal broths, concentrated but free of fat, should be the regimen. The fever being reduced, soft-boiled eggs, milk toast, and small bits of the white meat of chicken and tenderest steak may be permitted. Probably at least ten days or two weeks should elapse before the convalescent, by the easiest stages, should be permitted to resume ordinary diet.

HYGIENE OF PERSONS LIVING WITHIN AN AREA OF YELLOW FEVER INFECTION.

By Surg. H. R. Carter.

As I understand the problem the persons with whom we are concerned, living within a radius of yellow fever infection must more or less at intervals or continuously be exposed to yellow fever infection. The measure of no direct communication with infected points will then not be considered, although I think it will frequently be possible to substitute indirect communication for direct.

NOT ALL PLACES WITHIN RADIUS ARE INFECTED.

Probable limits of infection as to distance.

All places within a yellow fever infected district, or town even, are not infected or are infected in unequal degrees. The infection is especially confined to the habitations of men and their environment, and is conveyed a short distance, possibly 220 meters down the wind, from an infected focus. Two hundred and twenty meters is given as the maximum distance this infection can be conveyed, it being the longest distance claimed in any instance in modern times.

The general consensus, however, is that this observation (Melier's) is altogether exceptional, and that less than half that distance covers the distance to which the infection is conveyed from a single focus.

AERIAL CONVEYANCE GREATER IN LARGE INFECTIONS (PROBABLY).

Foliage obstructs spread.

On the other hand, it seems probable that if the focus of infection was large, i. e., a badly infected camp or part of a town, that the aerial conveyance of infection would be decidedly farther than from a single house or ship. I know of no observations on this matter. The presence of any object—such as a hedge of trees, bushes, etc.—which breaks the wind hinders the conveyance of infection.

PROBABLE MEDIA OF SPREAD.

Infection spreads in damp and shaded spots.

The microorganism, however, is unquestionably a saprophytic facultative parasite, and foci of infection can be established at a distance from the primary focus by the conveyance into suitable culture media of the microorganisms—thus, along sewers, about the dumping places of refuse, etc., and by fomites. For the same reason the infection spreads slowly along ditches and on damp and shaded grounds to a considerable distance, always to leeward. Taking all these methods of propagation, it may go far from the habitations of men and become general over all parts of a town, yet, in fact, seldom does so.

A place which has become infected may remain infected for a considerable period of time, being freed from it by cold weather, ventilation, etc.

"CONCENTRATED" AND DIFFUSED INFECTION.

We will consider, then, the (1) house infection, and (2) general infection—"out of doors" infection. This is frequently called atmospheric infection, but I think the term is liable to mislead. The first is in general far the most apt to infect one exposed to it—"concentrated," "virulent," is usually said of it. The latter, with the exceptions above indicated, is usually confined to the resident part of the town, and especially to the neighborhood of infected houses.

INFECTION GREATEST NEAR THE GROUND.

Activity at night.

The infection is heavy and hangs and spreads near the ground. It is unable to pass a close wall of any considerable height, although under the shady side of such a wall it may spread well when once started. It seems especially active at night, and certainly, out of doors, is less apt to be contracted on clear dry days. It is believed, I think, universally, to be taken into the human system by inhalation, although other avenues of entrance (besides the respiratory tract) are, since the observations of Sanarelli, accused by pathologists—rather from analogy, however, than from clinical observations.

RATE OF PROPAGATION OF INFECTION AND EFFECT OF WEATHER.

Dust as a propagator.

The rate of propagation of outdoor infection is increased in cities in dusty weather, apparently being conveyed with the dust. It is temporarily lessened after full rains, to increase more rapidly afterwards. Strong, steady winds in clear weather lessen the infection.

MEASURES OF PREVENTION.

With this brief résumé of well-known facts we can proceed. The measures seem naturally to divide themselves into—

(1) Selection and hygiene of the living place; (*a*) to prevent exposure to infection of its residents; (*b*) to prevent its becoming infected should fever develop among them.

(2) Guarding communication between known foci of infection.

Personal hygiene.

(3) Personal hygiene to prevent the individual from developing yellow fever.

(4) Measures to control (limit) infection when introduced in the living place—house, town, camp.

I. SELECTION AND HYGIENE OF RESIDENCE.

As far as the choice of a living place is possible it must be chosen, itself noninfected, as far from any known focus of infection, or residence portion of the town liable to be or become such a focus, as possible. It should, if sufficient distance be unattainable, be to the windward (prevailing wind) of such portion of the town or separated from it by trees, etc. All this is to prevent exposure to infection.

Elevated sites preferable.

It should be on high, well drained ground, as, if infected, the outdoor infection will be less. As much exposed to wind as possible and not so shady as to be damp—better too much sun than too much shade. I can not find that moderate elevation makes any difference to the house infection of yellow fever. Dryness, sun, and ventilation do.

WATER SUPPLY.

Probably not a waterborne disease.

Parenthetically it may be well to note that there is no reason to believe that yellow fever as usually propagated in this country is water-borne—the fresh-water tanks of infected vessels have never been and are not now emptied at our maritime quarantines. Nor am I aware of any facts which accuse this method of propagation in the tropics, and profoundly disbelieve that this is a usual method of propagation.

Yet from the analogies of growth of the bacillus icteroides of Sanarelli, most prominent now as a causative agent, with the colon group, it would seem well to secure a water supply free from possible contamination with this bacillus.

The same theoretical reasons exist to suspect food as a means of conveying the fever. There is less evidence of its innocence.

PREPARATION OF GROUNDS.

Draining grounds.

This place chosen for residence should be ditched so as to keep dry. Tile draining would be infinitely preferable, as the bottom of a ditch is shaded, and therefore damp. It should be kept very clean, and free from vegetable as well as animal litter, decaying leaves and wood, especially sawdust, seeming to be as bad as animal refuse. Brush, etc., must be cut out to let the wind freely through, and not too much shade be allowed.

CHARACTER OF HOUSES.

Construction of wood.

The houses should be preferably of wood, high above the ground, with free circulation of air under them; very open and light—as little shaded by trees as possible, depending rather on verandas and awnings for comfort. No dark closets—all to have windows, no understairs closets. Light and wind must go everywhere.

MOLD FAVORS THE DEVELOPMENT.

The writer observed (Annual Report of 1891) "the conditions which favor mold favor the spread of yellow fever on wooden ships." He has seen no reason to change his views.

Value of sun and wind.

Dryness of ground and of buildings, with free exposure to wind and as much to the sun as is allowable in a bad climate, with absolute cleanliness, are the conditions aimed at. This is to prevent or limit the extension of infection in this living place (house, town, or camp) if introduced, and if carried out we may hope to have no infection of the locality, even if cases of yellow fever are brought or developed therein.

If it be a camp, the people living in tents, it will almost always be practicable to prevent infection.

II. GUARDING COMMUNICATION WITH KNOWN INFECTED FOCI.

COMMUNICATION PREFERABLY BY IMMUNES.

Where communication with known infected foci can not be carried on by immunes, if it is practicable to make it indirect, this should be done. The direct intercommunication by immunes (or by nonimmunes not sleeping in the place which we wish to preserve from infection) is practically safe, if any reasonable supervision be given to it.

Where direct communication with towns where such foci exist must be practically unlimited, still the safeguard of "daylight communication" may be applicable.

DAYLIGHT COMMUNICATION.

Allowable on clear days at specified hours.

Under this, nonimmunes are all allowed to go into the infected town during the day, pledged not to enter any residence, and leaving town before evening. The hours in the town are usually from 9 or 10 a. m. to 3 or 4 p. m., and what part of the efficiency of this safeguard is due to nonexposure to infection by keeping away from the residence part of the town, what part to the short time spent in it, and what part to the fact of this time being entirely during the bright part of the day is difficult to determine; nor is it necessary. The method is not safe, but it is little dangerous, and if carried out in absolute good faith, and only on clear days, would be safe enough for all practical purposes—certainly unless the town were very generally infected.

DAYLIGHT COMMUNICATION IN CLEAR WEATHER ONLY.

The writer knows of two instances of persons who had thus entered and left an infected town a number of times on clear days with impunity, and who, after visiting it on damp, cloudy (muggy) days, developed fever. It would seem, then, that clear weather may be an added protection against outdoor infection. Theoretically it would be.

FOMITES.

Media of infection.

The risk of conveying infection by fomites to our people depends on (*a*) exposure of articles to infection and (*b*) capacity to retain infection. For the first, articles stowed away and handled in the nonresident portion (wholesale district) of the town are little liable to be exposed to infection. Of course, we may and do have infected warehouses in this district.

Household goods.

The capacity of an article to retain infection depends on the nature of its exposed surfaces. If these be hard, smooth, and nonabsorbent the article will be little likely to convey infection. Household goods are naturally most exposed to infection, and of these goods used bedding, upholstered furniture, and clothing are the most certain to retain it. They should be burned.

PASSING THROUGH AN INFECTED TOWN.

There is, of course, no special reason why articles of freight merely passing through an infected town should become infected in transit. The same applies to such articles stowed in noninfected warehouses.

III. MEASURES OF PERSONAL HYGIENE TO BE ADOPTED BY THE INDIVIDUAL TO PREVENT HIS DEVELOPING FEVER.

THE PERSON'S SURROUNDINGS.

Communication between houses should be limited.

(1) There are the obvious precautions that he should not expose himself to infection when practicable to avoid it, i. e., should not enter houses unnecessarily; should not go out of his own (uninfected) quarters at night; should not receive or come in contact with any fabrics or household goods about the exposure of which to infection there is doubt.

These precautions are of decided value, and by them and similar ones a man may live, and many do live, in towns in which yellow fever is endemic for a long time, and escape infection.

PERSONAL SUSCEPTIBILITY.

(2) Are there personal conditions which affect the susceptibility of an individual to yellow fever; and if so, to what extent are they under our control?

Here I must premise that on not a few points the opinions generally current, even among those best entitled to speak authoritatively on this matter, are founded on insufficient data, and are thus shrewd conjectures, based on general experience rather than scientific deduction from analyzed observations. Still, a consensus of conclusion, independently arrived at by men of wide experience and under varied conditions of observation, has a strong antecedent probability of being correct. It is therefore not intended to limit the recommendations on this subject to what is proven of value. A difference will be made, however, between such things as stand on good evidence and such as are merely current belief, confessedly an inconclusive data.

THE PERSON HIMSELF.

There are certain personal factors affecting susceptibility which we can not influence, and yet of which we may avail ourselves advantageously, as—

The negro race.

(*a*) The lessened susceptibility of the negro race.

(*b*) The lessened susceptibility of those living for years (better for generations) under the conditions which obtain in the tropics. Residence gives immunity.

ATAVISM.

It is this probably that gives the "relative immunity" of those suffering from "tropical anæmia" on which certain French writers insist. What influence ancestral amaryllization has is undetermined—probably considerable.

PHYSIQUE.

Thin, spare, vigorous men are less liable to develop the disease, and bear it well; the plethoric and full-blooded are more liable to develop it and have it severely. But this is nearly the same as saying that those suited by habit of body to the conditions of tropical life have a lessened susceptibility. Spare men withstand disease well.

PHYSICAL STATUS AT TIME EXPOSED.

To inquire into the conditions which affect susceptibility which we can influence we must note that there are many observations to show that the time and probably the fact of the development of yellow fever is determined by causes which affect the physical condition of the individual, such causes acting at the time or just preceding the development of the fever.

RESEMBLANCE TO MALARIA.

In this respect the disease resembles malarial fever, an attack of which will develop under certain conditions—mainly of failure of elimination of shock or of depression—which otherwise had failed of development altogether.

These causes in the main are those which diminish excretion and which depress. In the opinion of the writer (the contrary is held by most authorities) the former is the most important factor. Now, these causes we can influence.

MOST POTENT AUXILIARIES TO AN INFECTION.

To enumerate them about in the order in which they occur in frequence just before the initial attack:

(1) A sudden chilling of the surface, especially if wet with perspiration. This is common in the experience of every one. Chill.

(2) Excessive exposure to the direct rays of the sun. Exposure to sun.
The writer has seen but few cases of this. In all the sun exposure (exhaustion) was associated with a very dry skin.

It is much insisted on by Beranger-Feraud and some other French writers.

Fatigue.

(3) Excessive physical fatigue (in my experience complicated with (1) and (4)).

(4) Anxiety and mental distress generally, especially fear of the disease.

RELATIVE VALUE OF CAUSATIVE INFLUENCES.

To estimate the effect, and especially the comparative effect, of these things (many of them frequently acting coincidently) in determining the development of yellow fever is impossible, but that they do influence it is generally credited. There is so frequently a history of sudden chilling (as by a rain squall) of the surface, preceding by a short time the development of the fever, that it seems impossible to ignore its causative influence. The same is true to a less extent of exposure to the direct rays of the sun.

The influence of the others rests on much slighter evidence, mainly opinion, and to what extent these opinions are copied by one writer from another, and to what extent arrived at independently, the writer has no means of determining. He has never had any reason to accuse them as etiological factors.

DIARRHEA AND CONSTIPATION.

Febrile complication.

Diarrhea, common enough among those exposed to yellow fever, and certainly debilitating, has not seemed to induce (i. e., precede) an attack. The constipation nearly always associated with the advent of the fever will generally be found to have preceded it some days, and while it may be a prodrome, the writer is of the opinion (on insufficient grounds, he admits) that it has an etiological influence.

DIET AS AN ETIOLOGICAL FACTOR.

Meat diet.

A meat diet is claimed, too, to increase the susceptibility to the disease, as well as to make it more severe, the claim being made that the house servants (negroes) in Martinique and Guadeloupe, who live like their masters, took the fever more readily and had it more severely than the plantation hands, and, indeed, showed nearly the same susceptibility as the whites. The evidence seems insufficient, and certainly is not true to the extent here asserted of negroes in the United States. An over full meat diet, from throwing extra strain on the liver and eliminating organs, would naturally make the attack more severe, and may from the same cause increase susceptibility.

ALCOHOLICS.

The same is true of alcoholics, and it is well known that having used alcohol to excess is an element of decided danger to one who has the fever. I know of no evidence that the use of alcohol per se increases susceptibility. The habits of an alcoholic would increase exposure.

WATER AND FRUITS.

The free use of water and a diet of juicy fruits and fresh vegetables, increasing elimination by skin, kidneys, and bowels, should put a man in a better condition to go through the disease and probably lessen his chance of developing it.*

WHAT TO AVOID.

To state these conditions and to allege that they favor the development of the disease is to inculcate to their avoidance. The individual must avoid excessive fatigue and undue exposure to the sun.

CLOTHING.

Head covering

The use of a sufficient head covering is useful here, and nothing is so good as the thick pith white helmet. The white straw hat or duck cap with a handkerchief in it is good, infinitely better than the dark felt hat, or even than the hat or cap without the handkerchief, but nothing that I have seen takes the place with me of the pith helmet.

To avoid chilling the surface, flannel should be worn.

WOOLEN UNDERWEAR.

Shirts.

Drawers.

Indeed, in a tropical climate chilling is far more to be avoided than getting too hot. There is no need for two shirts, but let the one worn be flannel. A very thin shirt of other material may be worn under it if the skin be tender. The same is true of the leg covering, either flannel drawers or thin drawers and flannel trousers—the former preferably. In the opinion of the writer, from considerable personal experience, this rig is also most comfortable. The flannel shirt is more important than the drawers, as the body requires more protection than the legs. He should take proper precaution—waterproof blanket or coat—to keep dry. Should he go out at night, he should keep warm—take his coat. He should not cool off suddenly when wet with perspiration. He should not drink alcoholics, save when necessary to ward off a chill or avert serious fatigue. There is little risk of eating too much meat; there is little taste for it in the tropics, and it is extremely tough. He must not allow himself to become constipated. This probably is next in importance to the wearing of flannel and proper head gear.

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*The writer is inclined to believe that a diet with a little meat lessens susceptibility to infection, but the data on which this rests are insufficient to justify any save a "somewhat probable" opinion. A meat diet in the tropics is not wholesome, however.

Coats.

MENTAL STATUS.

Occupation of mind during epidemic.

Keeping the mind occupied and making light of the fever is probably the best way to meet the fourth indication, but the evidence that susceptibility is increased by fear of the disease is very slight (or nil).

Danger to life after taking fever is markedly increased by it. The most that can be hoped from all these measures is lessened susceptibility, and a considerable proportion of men will develop fever if sufficiently exposed to infection, in spite of them—a less proportion, however, than if no precautions were adopted. Their value is probably not great.

SANARELLI'S IMMUNIZATION.

The use of the serum of Sanarelli as an immunizing agent is subjudice. From the evidence he has seen, the writer would recommend its use. The use of other immunizing serums is so innocent, causing decidedly less inconvenience than vaccination, that even without pinning one's faith to its efficiency it would seem unwise not to avail ourselves of what is probably a valuable prophylactic, and if so, really the only one worth considering.

Its value.

IV. MEASURES TO CONTROL INFECTION WHEN INTRODUCED INTO THE LIVING PLACE.

PRIMARY CASES.

Should fever develop among the people the measures used for "first cases in town" are applicable to those that occur in houses, and, should only a moderate number develop, ought to succeed in averting infection of the locality. Indeed, a very considerable number will not infect the place if properly handled. The principles are well known and set forth at length in another paper. Early discovery of cases, isolation of the same, and immediate disinfection of

Early discovery.

the premises of the patient are the tripod on which these measures will rest.

TREATMENT "AT HOME" POSSIBLE, BUT NOT ADVISABLE.

Should removal of the patient be impracticable, rigid asepsis of his environment will frequently, and, under the conditions of life above described, generally, allow us to treat him at home without establishing a focus of infection; but it is less satisfactory and involves greater risk.

Prompt isolation and disinfection.

There should be no question of "suspects," the handling of whom is by far the most difficult question of house quarantine, as the cases among the people we are considering should be discovered early—within twelve, or at most twenty-four hours—moved away, and the place disinfected before it is capable of conveying infection to the other inmates of the house.

REMOVE ALL NON-IMMUNES WHEN POSSIBLE.

Detention camp.

If the patient is treated in his house, it is very advisable, I do not say necessary, to move the other nonimmune inmates out of the house. Should the people be in tents the well-known methods of the detention camp apply. These are well known, and if the condition be such that they can be used will prevent almost with certainty any infection.

"Suspects."

The problem here is simpler still, and the same principles apply, only we always move the patient. There are no "suspects." I think we can always prevent the infection of a well-situated, well-handled camp. Should we fail the camp is to be moved, disinfecting by aeration or otherwise all articles suspected of being infected.

HOSPITAL TO BE "CONSIDERED" AN INFECTED PLACE, BUT KEPT FREE IF POSSIBLE.

The hospital, regular or improvised, at which these people are treated must be treated as an infected place, but we can very generally prevent its infection if we have control of it from the beginning.

HYGIENE OF PERSONS LIVING WITHIN AN AREA OF YELLOW FEVER INFECTION.

By P. A. Surg. EUGENE WASDIN.

The rules of hygiene necessary to be observed by one exposed to the infection of yellow fever, either in a country to which it is indigenous or in one accidentally infected, are those which apply to the individual and to his environment.

AIR-BORNE DISEASE.

Yellow fever is essentially an air-borne infection, the entrance of which into the system has been supposed to be by way of the alimentary canal; the upper intestine serving the purposes of incubation of the causative germ; the absorption of its poison giving rise to the disease.

MODE OF INFECTION.

More recently it has been advanced that probably the germ of yellow fever enters the general circulation through the respiratory organs in some obscure manner, and incubating in the blood directly poisons this life-giving stream. However, this may prove to be, the present opinion is that one has not to contend with an organism or germ which may be taken into the body with food or drink, but with an almost inexplicable poison, so insidious in its approach and entrance that no trace is left behind. Individual hygiene for one exposed, therefore, is scarcely as important as the hygiene of his surroundings, for if these become infected there are no known measures for his protection that are in the least specific.

Hygiene of surroundings.

AVOIDANCE OF KNOWN INFECTION AND RULES OF PERSONAL CLEANLINESS.

The avoidance of localities and material known to be immediately infected is advisable. The observance of the rules for personal cleanliness is imperative. All undue fatigue should be avoided, and the question of suitable clothing carefully considered, for it would be equally wrong to burden oneself with clothing suited to colder climates as to too suddenly adopt the scantier raiment of a native. Good, warm underwear would prove grateful and prevent too rapid variations of surface temperature. Exposure to the heat of the sun should be as limited as practicable until one becomes accustomed to its influence. Exposure at night is known to be injudicious and should be avoided.

Clothing.

Night air to be avoided.

DIET.

While we do not know that this infection takes place by way of the intestinal canal, it has become the custom in those localities in which it is endemic to advise all who are first exposed to exercise extreme care in keeping the bowels in good order. It is very necessary that intestinal hygiene be carefully observed in all hot climates, and there is no doubt that the intestines present, in yellow fever, conditions which seem to connect them with the presence of the morbific agent. Therefore, the greatest regularity in taking meals should be observed; the taking of well prepared substantial food, such as one has been accustomed to, and in such quantities that there may result no incomplete digestion is advised. A careful discrimination is necessary in partaking of strangely-prepared dishes and of unusual varieties of fruit.

Intestinal hygiene.

DRINK.

As to drink, the use of boiled water, so much advised, can scarcely do more than prevent the introduction of agents capable of causing catarrh of the bowels, or fevers other than yellow fever. Still its use is advisable. Alcoholic beverages to one unused to them are harmful; to those habituated their use in moderation seems necessary in order to avoid that catarrhal condition attendant upon their too sudden withdrawal. Especially should unknown beverages be avoided.

Boiled water—alcohol.

PROPHYLACTIC MEDICATION.

The use of internal medication to ward off this disease is, I believe, useless, nor is it probable that sachets of camphor, or any other deodorant, do more than annoy one. Attention to these simple rules of living and early consultation with a physician if needed will serve to maintain the alimentary canal and skin in normal condition, thus

Organic disease should cause extra precaution.

directly enabling the system to overcome the morbific agent, or at any rate maintaining it in that condition most favorable to resist the infection should it occur. Nobody is prepared for this better than a normal, healthy one, and it is needless to add that it is wrong to expose oneself to this infection if there preexists any organic disease, for the chances of recovery are in direct proportion to the integrity of the great organs of life—the heart, liver, and kidneys. Any incapacity in these organs must contribute to the mortality in this disease, but scarcely adds to the probability of infection.

ENVIRONMENT.

Moisture, heat, and filth.

The hygiene of environment is the more important. While experience has shown that once introduced into a locality yellow fever may act without marked characteristics, yet the presence of dampness, heat, and filth seems to result always in a form of the disease more malignant than when these conditions do not exist. Therefore the selection of habitat is important.

DRYNESS AND ELEVATION OF APARTMENTS.

Good drainage.

One should select a dry, well-drained abode, to which sunlight has free access, and which can be thoroughly ventilated. There should be no stagnation of drainage or sewage, nor dampness to result in the growth of moulds; and to this end quarters elevated from the ground present attractions Although it is not known that animal or vegetable débris influences yellow fever infection, yet there is no doubt that their presence induces a lowered vitality, which makes one more liable to the infection.

SANITARY POLICING OF ABODES.

Disinfectants.

Therefore, thorough policing of one's habitation must be rigorously demanded, also the use of disinfectants to insure the destruction of offensive material. Finally, it may be noticed that there can be said, at this time, nothing which is specific. There is nothing which one may do directly to prevent infection after exposure. Many will escape, while others will succumb. A spirit of bravado or nonchalance is equally out of place with one of abject alarm. One should live in such a way that the precautions suggested above may be intelligently exercised, and he will have done all that a sound mind within a sound body can do.

HYGIENIC MEASURES TO BE ADOPTED BY PERSONS LIVING WITHIN AN AREA OF YELLOW FEVER INFECTION.

By P. A. Surg. H. D. Geddings.

PROCESS OF INFECTION.

While yellow fever is a communicable disease, it is not contagious in the ordinary acceptation of the term, but is spread by the infection of places and articles of bedding, clothing, and furniture. This is a process requiring several days (extrinsic infection), and during this period the yellow-fever patient is as harmless as one suffering from a surgical complaint.

AVOIDANCE OF INFECTED PREMISES.

To my mind the lesson is obvious, viz, that the nonimmune should avoid domiciles where yellow fever has prevailed or contact with articles or fabrics exposed during the course of a case of yellow fever, until disinfected by some approved method.

EPIDEMIC INFLUENCE.

While yellow fever is generally communicable only under the above conditions, it has been forced upon me that after the existence of yellow fever for some time and in considerable intensity in a locality the disease may be propagated by what, for lack of a better term, we are forced to denominate "epidemic influence." The question has puzzled me greatly, and I can offer no other explanation than that of an "intoxication," caused by the absorption or ingestion of "toxines" liberated by the yellow fever organism in the process of its growth, under favorable conditions, outside of the human body.

Toxæmia.

NIGHT INFECTION.

Experience has demonstrated that this infection seems less likely to occur during daylight than at night, consequently we can deduce that "exposure by nonimmunes to atmospheric influences at night is to be avoided."

INFLUENCES TO BE AVOIDED.

Chilling of the body.

Experience has demonstrated that during the prevalence of yellow fever in epidemic form, or in an epidemic habitat, anything which causes chilling of the body with consequent internal hyperæmias or congestions, predisposes to the invasion of the disease. Therefore, wetting by rain or dew is to be avoided, also the sudden chilling of the body when sweating by exposure to drafts or cold bath, when heated by exertion or when fatigued.

SLEEPING ON GROUND.

For the same reason, sleeping on the ground without the interposition of some impermeable substance is to be avoided, not that the ground is dangerous per se, but that it produces chilling of the body.

AS TO WATER SUPPLY.

Bad water.

While there is no proof that yellow fever is a water-borne disease, it is suggested that as a matter of precaution all drinking water be boiled before use.

FOODS.

Fruits.

While articles of food, especially fruit, can not produce yellow fever themselves, it is perfectly possible that in an epidemic habitat they may serve as vehicles of infection. Therefore they should not be eaten unless sterilized by cooking, preferably by boiling.

ALCOHOLICS.

Temperance in the use of alcoholics is to be advised, for the reason that the catarrhal conditions caused by their use offer less resistance to the invasion of the specific organism.

CATHARSIS.

Experience has demonstrated that during the existence of yellow fever in epidemic form, liability to the disease is diminished by keeping the bowels open by mild cholagogue cathartics. Excessive purgation is to be avoided, as tending to impair the force of vital resistance.

CLOTHING.

To prevent chilling of the surface it is recommended to wear light woolen next to the skin in preference to cotton or linen.

The use of hot coffee in the morning before going into the open air is to be recommended.

SUGGESTIONS TO PERSONS IN CITIES INFECTED WITH YELLOW FEVER TO PREVENT AN ATTACK OF THE DISEASE.

By Sanitary Inspector W. F. BRUNNER.

DEPOPULATION.

While the only positively safe measure to prevent the spread is to exhaust the material by depopulation of the infected city, a complete depopulation is impossible.

DAYLIGHT COMMUNICATION.

In the epidemic of 1876 at Savannah, Ga., it was the habit of several hundred business men to leave the city every afternoon before sunset and spend the night at some of the small towns near by, returning next morning after sunrise to pursue their different callings. But few cases developed among such persons. This plan was suggested after the manner of rice planters and their white managers, who, while daily visiting the rice fields, obtained freedom from attacks of malarial fevers by following this custom.

CHOICE OF RESIDENCE—BEST HIGH ABOVE GROUND.

There are other persons to be found in infected towns who are unable to leave the city for the night. To this class of persons it is suggested that they occupy living and sleeping apartments as far removed from the ground floor as possible, which should be on the sunny side of the house, and which should be aired daily during the middle hours of the day, and closed during the night as much as would be consistent with comfort. Avoid in every way exposure to the night air.

Avoidance of night air.

In a seaport or in a town on a river persons should be prohibited from sleeping near the wharf or river front. Every epidemic has shown that yellow fever attacks more readily persons living in such localities, and the fever assumes a more virulent form. My experience in Savannah, 1876, and Vicksburg, 1878, gave positive and practical evidence of this fact.

INTEMPERANCE DANGEROUS.

The avoidance of all intemperance should be practiced. Alcoholic stimulants are often indulged in, presumably to dull the fear of contracting the disease, but it is known that the highest mortality of yellow fever exists in those persons addicted to the free use of liquor.

DIET.

Foods should be avoided which are likely to cause irritation of any part of the alimentary tract, and as much care should be taken against the use of drugs so often recommended and used by the laity to prevent an attack of the disease. During every epidemic of yellow fever drastic cathartics are daily taken by the advice of druggist and friends. No more unwise course could be pursued. With a suspicious or doubtful water supply, boiled water should always be used for drinking purposes.

Catharsis.

Water.

LAUNDRY.

Care should be taken as to disposition of soiled clothes, as they may be taken to infected houses to be washed, and, while returned mechanically clean, may be infected.

POLICING PREMISES.

The daily removal of household wastes should be carefully looked after, and all back yards be kept scrupulously clean; great care should be taken not to use one or more of the numerous "so-called disinfectants," used so often to remove offensive odors, it being evident that to remove the cause of offensive odors is better sanitation than to stop one odor with another. Too much stress can not be placed on this suggestion. Damp basements and cellars should be dried and quicklimed at frequent intervals. Privy vaults should be frequently disinfected. The isolation of a patient suffering from an attack of yellow fever should be as complete as that of one suffering from diphtheria or scarlet fever. Care should be taken to sterilize all clothing and material in the infected room and to thoroughly disinfect the room and contents after recovery or death of the patient. It must be said that these sug-

Disinfect, not deodorize.

Dry out damp cellars, etc.

Sick-room hygiene.

gestions are applicable only to the intelligent, thinking class of a community; for all others sanitary policing by the controlling authorities is absolutely necessary.

TROOPS IN TROPICAL CLIMATES.

What has been said in the preceding remarks will apply but little to troops occupying cities and towns in Cuba. Havana, being the largest and most important city in the island, will be the point against which the main body of troops will be thrown, and, after occupation, will require a large force to garrison it. The number of the garrison should be at a minimum compatible with military safety. If possible there should be no men quartered within the city proper.

ALTITUDE AND DRYNESS ARE FACTORS IN CAMP SITES.

They should be camped on the high hills of the Vidado, lying west of the city. It may be suggested here that the wooden pavilion hospital Alphonso XIII, after disinfection, could be used as a barracks, care being taken to destroy those pavilions which have been used for the care of smallpox and yellow fever. This hospital has a capacity of 3,320 beds.

Alphonso XIII Hospital a good site.

CITY QUARTERS FOR TROOPS IN HAVANA

If it is necessary to quarter the men in the city, they should not be housed in any building before complete disinfection of the same, nor should they occupy any building east of that portion of the city bounded on the north by the Calle Prado.

OLD CITY IS VERY BAD.

The portion of the town proscribed is the old part of the city, and includes that part bordering on the bay. In my opinion, if it is absolutely necessary to have an armed force of men within the city, they should not be quartered in any building, but should occupy tents placed in the center promenade of the Calle Prado or Prado street. The street is the line of demarcation between the old and new sections of the city; it is about 220 feet wide and extends almost due north and south for approximately 1 mile, being intersected by what is called the Central Park. The center promenade of the street is raised about 2 feet above the carriage ways on either side, is about 70 feet wide, with

Prado a good camp site.

two rows of trees on either side furnishing shade during the hottest part of the day without entirely excluding the sun's rays; its surface being elevated above the carriage way, it is free from dampness.

RELATIVE SAFETY ON PRADO.

There is no question as to the wisdom of quartering the men in tents pitched on this street; many Americans have lived on this street during the writer's residence of one year, and they enjoyed immunity to yellow fever to a marked extent. With the men so quartered all requisites of sanitary policing could be rigidly carried out. Great care should be taken to prevent the men from having the liberty of the city, particularly that part of it near the wharves; night leaves of absence being prohibited.

This disposition of troops naturally can not be made in reference to other cities beyond the recommendation that if possible the men be quartered outside the different cities.

CLOTHING FOR CUBA OUGHT TO BE WOOLEN.

One of the principal precautions to be taken is in the matter of clothing. Flannel, light in texture and color, is the best material. Our ration table should be carefully looked after, as the ordinary ration will not answer in Cuba.

A PRÉCIS ON HYGIENIC MEASURES TO BE TAKEN IN A TOWN INFECTED WITH YELLOW FEVER.

By Surg. H. R. CARTER.

WHEN TO ESTABLISH PROVISIONAL QUARANTINE.

In general* on the credible report of yellow fever, or suspicious fever, at a place, steps should at once be taken to prevent people and goods from that place leaving it. This should be done pending investigation, which should be immediately made, and the quarantine proclamation should announce that it is temporary and only until investigation is made. For this time, however, the prohibition should be absolute (save possibly for those certainly going to places incapable of infection by yellow fever, and to remain in such places). This is necessary because one case reported may mean a thoroughly infected town, and the exodus, almost certain to take place on the report that an investigation is being made, may do irreparable damage. With this had best be also included (in partial quarantine at least) such places as from communication with the quarantined place would naturally share its infection should it be infected. Thus a quarantine (temporary) of Biloxi and other coast towns had been advisable when fever was reported at Ocean Springs.

WHEN QUARANTINE IS NOT NEEDED.

(1) When the case reported is reported as an "imported case" (i. e., is believed to have contracted infection elsewhere), and is reported early.

The presumption then is that there is no focus of infection in town, and if this be true, quarantine is unnecessary.

An example is the De Villa case in New Orleans in 1889. This man contracted yellow fever in the tropics (Livingston, I believe) and developed it in New Orleans (or en route) and died in New Orleans on October 3, 1889. It was obviously not contracted in New Orleans; its presence showed no focus of infection there, and quarantine on account of this case was unjustifiable. Similarly the Gelpi case of 1897, obviously contracted in Ocean Springs, gave no sufficient reason for quarantining New Orleans, although the known communication of New Orleans with Ocean Springs, I think, did justify partial quarantine independently of the report of any case.

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*I say "in general," because there are conditions in which this is inadvisable.

An example showing where this rule had led to error, however, is afforded by the Branham case of 1893, at Brunswick, Ga. This case was reported, and believed, to have contracted fever at the quarantine station and was brought to Brunswick. If this were true this sickness was no evidence of focus of infection in Brunswick, and hence no absolute quarantine was laid pending investigation; only an inspection quarantine was put on to prevent persons going by common carriers from Brunswick to infectable towns south, such as Savannah, Jesup, Jacksonville, etc. On investigation three other cases were found, and on the finding of the second case an absolute quarantine was laid. In the meantime people had driven out from Brunswick to country places near by, and indeed to some distance, and from one of them, Jesup indirectly received its infection.

What credence to give to the reported origin of a case of yellow fever reported in a town prior to a full investigation is often a serious problem; but the consequences of delaying action, should immediate action be needed, are so deplorable, that, if doubtful, a temporary quarantine should be laid.

(2) When the town is large,

There are three reasons for this exemption.

(*a*) The chance of a large town having much infection in it with the report of the first case is minimal, and is not possible if the health officers act in good faith.

(*b*) An exodus from the investigation is little apt to take place from a large town. It is certain to do so from most small towns, and the town being (proportionately) less infected, such exodus as might occur is less dangerous.

(*c*) The loss occasioned by the quarantining of a town is in direct ratio to its size and the length of time it is maintained; and, as the time required to make a satisfactory investigation of a large town is considerable and may vary considerably, the loss from absolute quarantine of a large town pending investigation would be very much greater than for a small one (probably about as the squares of their population).

It seems, then, that to omit the quarantine of a large town pending investigation is less dangerous and to institute quarantine more injurious than in the case of a small one, and I think in general quarantine should not be imposed on a large town pending investigation.

INVESTIGATION OF EXISTING FOCI.

Having determined on the diagnosis of the reported case or cases we should, if they be found to be yellow fever, find out—

(1) The source of infection.

(2) The amount of infection.

(3) Who has been exposed to that source or to the foci (presumably) established by the sick in town.

I. SOURCE OF INFECTION.

The determination of the first may enable us to pronounce the case an imported one, and possibly relieve the town from quarantine. It may enable us to suspect a focus of infection in an unsuspected town, as the case reported by Holloway in Louisville in 1897 led to the investigation of Ocean Springs, Miss.

Yellow fever in a resident (as in a new comer from a place where no yellow fever exists) is strong evidence of a focus of infection in town, and hence of other cases.

II. AMOUNT OF INFECTION.

At the same time, an investigation of other cases of fever in town should be made to determine their nature. A rapid examination of the mortuary reports for the past six or three weeks—a more complete examination may be made later—and such diagnosis investigated as fatal cases of yellow fever are liable to be reported under. This is especially necessary if the source of infection be unknown. Following the preliminary investigation, a careful house-to-house inspection is, for a small town, always to be instituted.

III. EXPOSURE TO INFECTION OR TO THE SICK IN TOWN.

While investigating the source of infection and determining the existence of other foci or cases in town we must find the location of all who have been exposed to infection, whether from the original source or foci of infection, and to the (possible) infection of the premises of the sick. These are the "suspects."

This is a most important and difficult inquiry and the success of the measures, if it be suppressible, depends mainly on its thoroughness.* In this connection it must be remembered that the infection of yellow fever is transmitted a little way aerially, especially down the prevailing wind, and there are instances of the measures above described proving futile because the residents of houses adjacent to the infected premises were not counted exposed and therefore kept under observation. It was partly to a careful watch of the houses to the leeward of the infected premises that the suppression of the yellow fever at Franklin, La., in 1897, was due.†

How far infection can be conveyed aerially may be a question. Mèlier's celebrated case at St. Nazaire, in 1861, I think, reported to have contracted it at a distance of 220 meters, and the writer reported a case in 1891 where the apparent source of infection was a measured 70 fathoms distant. Still, these cases are altogether exceptional, and it is so difficult to eliminate all possible chances of infection that it may be that the apparent source of infection in both of these cases was other than the one considered by the reporter.

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*The writer has on two occasions found that the laundress, to whom the soiled clothes of the patient had been sent, had not been considered in enumerating those exposed to infection. Inquiry must be made of these and all other articles leaving the house since the sickness began.

†In the town of Franklin every physical condition against controlling the fever seemed to exist, and yet it was controlled.

There is no question, however, that infection is not infrequently taken from a focus across an ordinary street, and in my experience this is about as far as it is transmitted.

CONDITIONS WHICH DETERMINE QUARANTINE.—PARTIAL QUARANTINE.

As soon as the nature and extent of the infection and the measures to prevent transmission of the disease in the town are sufficiently determined, we can determine on the measures of quarantine, if any, which should be adopted against the town.

The first question to be determined is, Does the place require quarantine, or shall that put on pending investigation be raised? (A) If the disease be certainly confined to a few houses and all who have been exposed to possible infection be known and this house or these houses and all exposed to infection be under guard and sanitary supervision—i. e., "in quarantine," quarantine against the town may be raised.

If in doubt whether all who have been exposed to infection are under observation, it will be necessary to wait some time greater than the maximum period of incubation of the disease before doing this, and if no cases arise in the town we can lift the quarantine. Proper precautions to prevent infection from every possible focus having been observed, this, of course, is equivalent to holding the whole town under observation, "in quarantine," and implies a careful and frequent inspection.

WHEN DISEASE OCCUPIES RESTRICTED LIMITS.

(B) Similarly, if the disease be confined to a portion of the town and this portion can be efficiently isolated from the remainder, this may be done, and this clean part of the town used as a detention camp; and after the period of incubation has passed, there being and having been no fever among the residents, they may be released from quarantine.

Since the release of these people from quarantine depends on no fever developing among them, a most careful inquiry for those of them who have been exposed to infection should be made, and these should be removed from this part of the town.

FOMITES.

Care must be taken with clothing, etc., of these people, not only to prevent them carrying possible fomites out of the quarantine, but to insure that they are not exposed to infection from fomites while they are undergoing their detention. To require the disinfection, when they leave, of the clothing which they take with them is wrong in principle. If this stuff, or any in the house, be infected, these people are continuously exposed to infection and should not be released. If it be not infected disinfection is not needed.

By going through the premises carefully when the isolation is begun we can very generally determine if there be anything in the house which requires disinfection, and if there is it should be disinfected then, not later.

It was on this principle that in 1897 the camp grounds and Heartease Park were isolated from Biloxi, with which they form almost one town, and the residents given pratique after ten days. The same was done in 1893 about Waynesville, Ga., and in both cases a considerable number of people relieved from quarantine restrictions with safety.

It is thus seen how the quarantine laid against a town pending investigation will be modified both by the amount of infection and by the sanitary measures taken. The fact that it will be so modified is an added inducement to the town to take proper sanitary measures.

COMPLETE QUARANTINE.

I do not propose to discuss the methods of putting on a general quarantine against a town, as the problem varies ad infinitum. Whether a cordon forbidding all direct egress of persons, etc., be established; or whether it be limited to guards on the general lines of travel, including dirt roads; or simply to railroad and water craft, will depend, as will the degree of communication authorized, on local conditions. The first, of course, should give the most security. For a large place it is generally impracticable, owing mainly to the territory immediately surrounding a large town maintaining direct communication with it, either unlimited or surrounded by certain safeguards, as "daylight communication." This makes the extent of territory exposed to infection too large to be surrounded by a cordon. Whether this direct communication should be permitted by the health authorities depends on the risk of spread of infection outside of (and in) this "neutral territory," and must be decided on its own merits for each case. It increases this risk.

A word about "daylight communication." Briefly, this is direct communication with an infected town. Persons being allowed to visit it during the daytime—hours generally 10 to 4—under pledge to enter no residence, attend to their business, and return home. People living in the infected town are not allowed to enter the clean one, and certain classes of (or all) merchandise are barred.

It depends on two principles:

(*1*) *That the infection of yellow fever is mainly confined to the habitations of men and their environments.*

(*2*) *That the disease is not liable to be contracted in the daytime.*

The first is unquestionably true, and in towns which have a business district distinct and at a considerable distance from the residence portion there is extremely little risk of infection in the business portion of the town night or day, unless the infection of the town be very general.

The second is, I think, true to some extent, and if *bright, clear day out of doors* be substituted for "daytime," probably to a very considerable extent. Still, most of the evidence brought forward to establish this point involves the first also.

The fact remains that people entering a town infected with yellow fever, for business only, coming in after the sun is high and leaving before the late afternoon, rarely contract fever. The instances, however, where communities allowing "daylight" communication have received infection are not rare, and while we (and they) generally explain it by showing that it was some carelessness or bad faith of the person who brought the fever, still, the fact remains, and places holding such communication for a long-continued period will frequently become infected. In proportion as this privilege is confined to reliable business men, to short hours, clear days, and rigidly supervised, it is safe (or rather little dangerous), but women are prone to visit friends.

The detail is easily worked out.

As a general principle in quarantine operations the guards are most efficient if taken from the country to be protected rather than from the town quarantined, although we always desire to make all possible expenditures among the people of the town, because they need it.

WORK IN THE TOWN TO SUPPRESS FEVER.

The question here is, Can the fever be suppressed?

(A) If there be few foci in town, and they be known, there is good chance of suppressing the fever. If, in addition, all who have been exposed to infection are known and can be properly provided for, this chance is much increased and we can usually attain success.

Thus, at Cayuga, Miss., in 1897 Dunn found two foci of infection. Those who had been exposed to infection were in 13 other households. These were kept under observation. In 5 no fever developed in ten days, and they were released. In the remaining 8 fever developed and went more or less through the households. Proper and efficient sanitary measures of isolation and disinfection were taken, and there was no further spread. Similarly, at Franklin, La., although the problem was more difficult, as it was not possible to determine all who had been exposed to infection, yet by similar measures and careful inspection the same result was attained, as also at other places.

(B) If the fever be confined to one section of the town, even if pretty general therein, it may be possible to so isolate that part as to preserve the remainder.

This was successfully done in 1897 at Clinton, Miss., by Waldauer and Mayor Coleman. A cordon was placed about the infected portion of the town and the disease was confined to 18 houses—about 73 cases—the remainder of the town, about 200 or 300 houses, escaping. This work and at Cayuga, by Dunn, mentioned above, must be characterized as brilliant.

DISPOSITION OF PATIENT HIMSELF.

The patient should if possible, and it generally will be impossible, be moved to an isolated place or a well-appointed hospital. We can practically always keep such a hospital from becoming infected and the infection of an isolated place, should we fail to prevent it, is little dangerous.

How much risk should be borne by the patient and how much by the community is a question which the health officer must consider in advising removal. In general, removal during the first forty-eight or sixty hours prior to the "stage of calm" is not specially injurious. We habitually remove the sick from vessels during this time, and they get well. After that time it is to be deprecated.

PREMISES WHERE PATIENT IS TREATED, AND HIS ATTENDANTS.

If moved, all possible precautions to prevent infection of his new quarters must be taken, and I believe we can very generally succeed. If he is not moved, precautions to prevent infection of the premises are even more necessary. They will be less often successful.

Cleanliness, dryness, good ventilation, sunshine, are all important. No fabrics, carpets, hangings, etc., not absolutely necessary, should be allowed in the room. The clothing, bedding, etc., which go with him if moved must be immediately disinfected. A rubber sheet to protect the mattress must be on the bed. The bed linen and shirt must be changed daily, oftener if soiled; the rubber sheet changed when necessary. All fabrics used about the patient should go immediately—in the room—into an antiseptic solution. The floor is to be wiped up daily with a similar solution. All excreta* should be disinfected or destroyed, and, in short, every detail to prevent contamination of environment by the patient be carried out.

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* Observations by Archinard, shortly to be published, gave no cultures of the *B. Sanarelli* in the urine or black vomit; rarely in the scrapings of the skin (face, throat, and chest); more commonly in the exhalations and excretions of the mouth. As this bacillus is found in the blood, it may be that the blood from the gums was the source of contamination. That it was not found in the black vomit (blood), may have been due to its acidity. The fæces were not examined, but from the similarity of the behavior in cultures of this organism and the bacilli of the colon group and the fact that abrasions of the intestinal mucous membrane, and hence the exudation of blood in the intestine, are universal in yellow fever, it is highly probable (certain?) that the fæces do contain this organism in large number and are thus the main source of its elimination from the patient. One case in Franklin in 1897 is traceable very clearly to fæces or urine of a yellow-fever patient.

PROPER AND INTELLIGENT ASSISTANCE.

The presence of intelligent trained attendants is necessary to carry out these measures, and no consideration of economy can be allowed to come into conflict with this effort to prevent the establishment of a new focus of infection.

The above principles are to be observed in the premises in which the patient is treated, whether they be those in which we find him or those to which he is moved. They are to prevent infection or further infection. If he be treated in the house in which we find him—presumably infected before the institution of these measures—such measures as are possible to destroy the infection, which already exists, must also be instituted.

If possible, prepare a room for the patient on the upper floor, which is sunny and well ventilated, by removing all superfluous fabrics, etc., and scrubbing it out with bichloride solution; then move him into it, and keep it clean. Disinfect as well as can be done without disturbing the patient, and very efficient work can be done. Everything possible must be disinfected—scrubbing all parts of the house, the late sick room especially, with bichloride solution, disinfecting (or destroying) the used bedding, upholstered furniture of the room, etc., and keep the house, the sick room especially, open to sun and wind to the fullest extent as long as it is dry weather.

Pay especial attention to the places where the excretions of the patients have been thrown and to any soiled clothing that has been used about him, etc., and, finally, as much cleaning up and disinfection outside the house as can be done and may be needed, should be promptly attended to.

The only town in 1897 (until cold weather) which could show a single case of fever without any spread was Perkinston, Miss., where a very careful disinfection was begun on the third day of the disease and a careful asepsis carried out to the end. The premises, also, were under guard. The work planned as above was carried out by Dr. Champe, of Perkinston.

If the patient be moved, the premises are to be disinfected by immunes, who need only disinfect their clothing, hair, hands, etc.; or, if this be impossible, by nonimmunes, who must disinfect the same way and be treated like the original nonimmune inmates of the house.

The house in which the patient is treated (unless a hospital, which we feel sure we can keep free from infection) is to be treated, until it is disinfected, like an infected place, although we can frequently prevent its becoming so. It is to be put under guard and no ingress avoidable allowed. There is no theoretical reason why egress for short periods (hours) should not be allowed to those feeling perfectly well if sure of the sterility of their clothing, hair, etc., and it would keep them in better health—hence less susceptible to infection—to take exercise. Yet, owing to the willingness of people to take risks for their neighbors and the rarity of sustained carefulness in the laity, I would in general not advise this. Hence, no egress. Still, there may be circumstances in which this may be allowed. It can be made free from danger by intelligent supervision.

PRECAUTIONS TO BE TAKEN BY ATTENDING PHYSICIANS.

The physician, if not immune, must take precautions not to establish a new focus should he develop the fever, regulating his disposition of himself on the hypothesis that he will develop it. He should especially not sleep at any house in which it would be objectionable for him to develop fever. It seems to me best that he should stay on the premises with the patient. In any case he should wear clothing little liable to convey infection—linen or other smooth clothing, or change it if he goes out. I know this is very seldom necessary, but sometimes it is, and *if the patient be regularly attended through his illness, and much time spent in his room*, there is a slight indeed, but real, risk of conveying infection in this way.* These precautions are recommended only when there are very few patients and every real risk, however slight, is to be avoided.

PREMISES CONSTANTLY UNDER GUARD.

Until these premises are released from observation they must be under guard. This has already been stated. These guards should be immune and precautions taken against the conveyance of possible fomites by them.† If immunes are unattainable, the guards must be under closer supervision, as they will be exposed to possible infection. They must sleep in the guard camp, be inspected twice daily, and other precautions taken, lest they establish new foci, if they develop fever. They should be, of course, as little exposed to infection as possible, and it is, indeed, generally nominal.

DISINFECTION OF PREMISES.

The premises of the patient and all things in them, including the patient and attendants, must be disinfected as soon as possible on his death or recovery, using the precautions about the disinfectors previously given.

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*The writer believes (oral communication from Dr. Tarlton, of Patterson, La.) that yellow fever was thus conveyed to Patterson in 1878, and considers it very probable (oral communication of Dr. Folkes, of Biloxi) that it was thus conveyed in one instance to a house near Biloxi, Miss. In both cases the physicians, believed to have conveyed the disease, had been long in the infected rooms (which were badly infected) and in prolonged intimate contact with the sick, his bed, etc., and indeed under the conditions usual with nurses rather than physicians.

†Three instances have come to the writer's notice of foci of infection established by guards.

WHEN DOES CONVALESCENT BECOME INNOCUOUS?

At what time during his sickness or convalescence a patient becomes incapable of infecting his premises I do not know, nor can I find any observations or even opinions on this subject, and yet it is a very practical matter for sanitarians.

DISINFECT NEIGHBORING PREMISES.

The premises adjacent to those of the patient which from propinquity, communication, or direction of wind can reasonably be judged to have received infection are also to be disinfected.

DEPOPULATION.

In addition to these means to prevent infection of premises and, failing this, to isolate them, a most valuable adjunct in suppressing yellow fever, existing under the described conditions, is depopulation of the neighborhood and of the presumptive focus. How far this should be done is implied in the paragraph on aerial transmission of infection; but the wider and more completely (within limits) it is done the better from a sanitary standpoint. Reasonable precautions are to be observed lest new foci be established by some of these people who have been already exposed to infection. (See "Disposition of suspects.")

This depopulation, however, is meant to extend well beyond the distance to which fever may be reasonably expected to be aerially transmitted from the focus, the intention being to render the focus as isolated as possible from people. Indeed, a general depopulation of the town, safely done, is of much aid in suppressing the fever. In general, however, it is scarcely advisable.

DISPOSITION OF SUSPECTS.

Now the inmates of the house of the patient (unless immune to yellow fever) should be removed from the house, all clothing, etc., disinfected, and kept under observation, "quarantined," in a place free from infection and so situated that if any of them sickens he may not establish a focus of infection dangerous to the community, i. e., either in locality insusceptible to infection as to northern points, Atlanta (Arbita Springs?), etc., or so isolated by distance and guards that its infection will do no harm to others (Camp of Detention). Indeed it is not generally difficult to prevent such a place from becoming infected with yellow fever, if one has charge from the beginning of a suitable place, even if fever develops among the suspects.

These people, if in an infectible locality, should be inspected twice daily until the period of incubation has passed, and if one of them sickens, he must be promptly isolated from the remainder (or better, left where he is and the remainder isolated from him) and measures of disinfection taken. If in noninfectible territory all this is unnecessary.

If it be impossible to remove the inmates to a place of safety (it should never be, save by their own will), they must be quarantined in the house. This is bad—bad for them and bad for the community—because there is thus risk of prolonging the existence of the fever in the infected house. Their own risk being optional, they must take it for the safety of the community. Here measures previously inculcated to prevent infection of the house are especially necessary.

It is to be noted that if the case be discovered early—time limits not definitely determined—the premises apparently are not yet capable of communicating infections to persons, and the inmates have not, so far, been exposed to chance of infection. This is a reason for their prompt removal, and the statement one so often hears, "I had as well stay, as I have been here —— days," should never be allowed to weigh with health officers in allowing these people to ignorantly risk their lives.

Those who have been exposed to infection—not inmates of the patient's house—must also be provided for. If possible they should be sent to noninfectible territory or to an isolated place (Camp of Detention) and kept there under observation during the period of incubation of the disease, due care being taken that they are not exposed to any infection, as by fomities carried in, while isolated.

If neither of these methods are practicable, they must be inspected daily or, if possible, twice daily at their own houses, and measures, as before indicated, taken should they become sick.

There is no theoretical reason why these people may not pursue their ordinary avocations while well, as during the stage of incubation the disease is not transmissible, but there is every reason why they should not sleep away from home (fever very generally developing at night), and, unless they be trustworthy, they had best be kept on their own premises. It is to be noted here how rarely people taken from infected premises and placed in camps, or under the conditions of camp life, develop fever. Whether it be the relief from anxiety or the open-air life, the fact remains that the development of fever among suspects in camp is rare. I know of no definite comparative statistics, but the fact has been remarked by all who have had experience and whose attention has been called to it, that development of fever among people in camp is far less common than among an equal number isolated in their own houses.

Measures of this kind are taken for the purpose of preventing further development of the fever—"to stamp it out." They certainly give a fair chance of success if the early cases are reported. Failing this, they will greatly retard its rapidity of spread and will have done good in proportion to the lateness of the season. Indeed, if the season be very late, it may be advisable, in spite of what will be said presently, to continue these measures or a modification of them even after we have no hope of suppressing the fever by their means, for the purpose of lessening the rapidity of spread of the fever, which is then extremely desirable, being indeed equivalent to an earlier frost.

The stringency with which they should be then administered depends on many conditions, mainly the lateness of the season. A balance is to be struck between the good to be gained and the hardship imposed.

HOUSE QUARANTINE OF NO AVAIL IF MANY CASES ARE CONCEALED.

And here let me also say that the measures above outlined for use prior to an epidemic are recommended where practicable—i. e., when the authority or influence of the health officer is sufficient to carry them out.* Should the condition be such, however, that the attempted enforcement of these restrictions leads to the successful concealment of cases they must be modified, *as successful concealment of cases takes away all chance of suppressing fever.*

Our reliance is then placed on preventing the infection of his environment by the patient and preventing ingress. Above all, the first is important and is to be depended on. The presence of the sanitary inspector and of the trained nurse necessary to carry this out are such boons to the patient that we may be sure that no cases will be concealed on account of these measures, if reasonable tact be used.

Indeed, the aim must be in all cases to make the household with the yellow fever *a privileged one*, so that it will be to its interest if there be a case among them to have it officially known.

To this end physicians and medicines, delicacies for the patient, and even subsistence for his family free, are wise sanitary measures as well as charities.

Remember, if cases are concealed to any considerable extent our chance of suppressing the fever is lost.

MEASURES NECESSARY WHEN THE FEVER CAN NOT BE SUPPRESSED.

The townspeople are always loth to recognize that this condition exists, but when we find cases arising of which we can not trace the source of infection, when we are unable to efficiently carry out the measures here outlined, or when cases are being successfully concealed we may know that the fever will not be suppressed until it has run its course or cold weather supervenes.

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* Obviously it is implied that the state of feeling in the community is to be taken into consideration also. Measures which will be readily agreed to and carried out in good faith in one community will excite violent and unconquerable opposition in another.

The observation of the writer is that, in small towns at least, Americans of English descent will willingly bear any reasonable amount of inconvenience and some hardship if convinced that this is necessary to avert a greater calamity from the rest of the community, whether of their own town or neighboring towns, and if convinced of the reasonableness of the measures to be taken will assist in carrying them out. The case of Jesup, Ga., which closely guarded itself, well illustrates this, as does the "house quarantine" in Franklin, Perkinston, and several towns in north Mississippi. It is paralleled by the history of not a few English towns with the plague. The sense of duty to the community seems to be strong.

ILLICIT COMMUNICATION.

An infected town is a source of danger to its neighbors, no matter what means of quarantine are taken. This is because a certain amount of illicit communication from the town to clean territory will be kept up, no matter what rules and regulations are made. The danger is almost exclusively due to those who leave the town for infectible territory. It is in proportion to the number who thus leave directly and to the proportion of infection in the town, hence to their product. Thus, 100 persons leaving when there is 1 per cent of the town infected conveys the same risk as 10 people if 10 per cent of the town be infected.

It is our aim, then, to reduce the number who leave directly for infectible territory to a minimum (and, if possible, have none to leave). But to take such risk of leaving as must be taken rather in the beginning of the fever, when there is little infection, than later, when there is much more, we first take measures to prevent these people leaving directly without sanitary supervision—i. e., establish quarantine, and, second, arrange for their leaving under such conditions as will not convey infection to clean territory.

MAKE LEGITIMATE COMMUNICATION EASY, AS BEST PREVENTIVE OF ILLICIT.

This allowing some means of egress from the infected town should go hand in hand with the prohibition of unsafe egress, not only on the ground of humanity to the townsfolk but because a legitimate means of egress being provided, the number of attempts to pass the lines in other ways—a certain proportion of such will succeed—is enormously lessened, *and the providing of a legitimate means of egress, if safe, is an added safeguard, and an important one, against the infection of clean territory.*

While it is scarcely necessary to cite instances of this, many can be given; it is self-evident, certainly to all who have had experience of epidemics and seen the imperfection of the best devised prohibitive measures. On the same principle this means of egress should not be made more difficult than is necessary for safety. We wish to encourage its use; to have it, rather than an "underground railroad" selected by those who would leave.

Depopulation, then, which has long been recommended as a valuable means of lessening the horrors of an epidemic in the interest of the infected town, is not less valuable as a protective measure to the surrounding infectible territory.

EARLY DEPOPULATION SAFER THAN LATE DEPOPULATION.

Stress should be laid on early depopulation. There is then not much infection in town, and not only are people who leave escaping risk to themselves by leaving early and lessening the rapidity of the spread of the disease in the town, but the chance of infection of outside places from any mishap which may occur is less than if it should happen later.

CLASSES WHO MAY LEAVE.

All who have been certainly not exposed to infection, which we would be able to say of few later, should go without let or hindrance.

The others may go (1) directly to points incapable of receiving the infection of yellow fever, generally northern points—high altitudes—to remain there indefinitely, or for a time to cover their incubation; (2) to points capable of receiving such infection but through a camp of detention.

By a "camp of detention" is meant any place at which these persons stay unexposed to any infection a sufficient time to cover their period of incubation. No infected article going within.

PEOPLE LEAVING FOR NONINFECTIBLE TERRITORY—POINTS NORTH.

(1) How to get these people through infectible territory to their destination without infecting it is a problem of "traffic," and will be there considered. Before these people are allowed to go north we must be assured that they will remain there to cover the period of incubation of yellow fever, say ten days, or indefinitely, i. e., after frost.

TREATMENT OF BAGGAGE.

Disinfection of baggage is not necessary for such people. If, however, they will return after a time to points South, their baggage must be disinfected on departure. Indeed, if there be any reasonable doubt of their not returning, the burden of proof being on them, disinfection of baggage must be done.

The methods by which the train inspector, on whom this work falls, assures himself (1) that a passenger intends and will stay North indefiinitely, and (2) that he will stay ten days and not double back, must be worked out for each particular epidemic, and to a certain extent to each particular road and case. A good man will err by over suspicion and hard rulings.

TRAIN INSPECTIONS.

A person leaving New Orleans in 1897 took an affidavit—the stub of which was preserved by the train inspector—that he "would not return to any place quarantined against New Orleans" or that he would not return to quarantining place "for ten days." In the latter case his baggage was disinfected and a certificate of disinfection given him giving the date of his departure from New Orleans, and of course the same date of disinfection and the number and kind of pieces disinfected. A label of thin paper was then pasted on each piece of baggage. The certificate of date of leaving New Orleans had a personal description, and the baggage label was made of thin paper so it could not well be detached and used over again. It had the name and date on it, and was signed.

It seems best to disinfect all baggage going to remain at points like Atlanta, Charlotte, Nashville, etc., which are great distributing points for railroad travel south, and the only baggage ever sent to any such places undisinfected in 1897 was that of some schoolgirls going to Nashville to a seminary the latter part of October. Indeed, Atlanta required this to save herself from quarantine by the coast cities.

There seems no reason why baggage going north through these places should be disinfected, any more than Havana baggage going by the Ward Line to the same points. Indeed, there is good sanitary reasons for not doing so. Every obstruction, however slight, put in the way of people leaving an infected town to some extent prevents their leaving and to a disproportionate extent induces them to put off leaving if they do leave. We want them to leave early. Again, as before said, no quarantine is perfect, and in proportion as a safe and legitimate way of exit is obstructed the illegitimate ways are sought, which is (especially if sought after the town is well infected) dangerous in the extreme to the territory we seek to protect.

Unless we have been in an epidemic on the inside we fail to realize what slight obstructions prevent people leaving an infected town by the ways provided and induce them, for the purpose of avoiding moderate inconvenience, to take sanitary risks for others which are simply appalling. The rule which should obtain, then, would be to "require everything which is necessary for safety and nothing which is not necessary," throwing, of course, the doubt in favor of stringency.

Arrangements should be made with sanitary inspectors at places to which most of these people go to return South again—Atlanta, Nashville, St. Louis, etc.—so that they can keep some supervision of them and see that they do not leave for the South until their ten days are past. It would not be difficult to arrange for a pretty fair supervision. It will require to be supplemented by a train inspection south from some of these places. This latter has always been put on.

(2) Persons leaving for infectible territory through a detention camp. The method of conducting detention camps in detail will not be described. They require much pains and care in their management. I would again call attention to the sanitary protection they afford to the quarantining places as well as advantage to the infected town by letting its people escape. By providing a safe and allowed means by which people who can not go North can leave the infected town, the effort to evade quarantine restrictions is lessened and the seepage, so to speak, through the cordon is minimized. It is extremely difficult to prevent people evading quarantine who have friends willing to receive them outside, and these are the very people who will go through a camp.

For the same reasons as given for not disinfecting through baggage, the camp should be made as pleasant as possible, and impose no restrictions which are not necessary to prevent the conveyance of infection. The writer holds that it should be known that it will not be held open indefinitely, but be closed after a limited time, so that those intending to avail themselves of it should not unduly put off coming to it. The earlier the people come to camp the less fever will develop among them; and while the development of fever at a camp is to be expected, yet it is to be averted as much as possible. It is surprising how little does develop.

WORK IN THE TOWN.

It is no part of this paper to describe the "relief measures" to be taken in the town for the care of the sick, relief of pecuniary distress, etc., only such as appertain to purely hygienic "quarantine" work. They have, consequently, not been considered. They are not the less important.

A modification of the measures of disinfection and isolation heretofore outlined may be of use in lessening the rapidity of spread of the fever even when we no longer hope to suppress it, and I quote from the latter part of a paper read by title at the Mobile Conference, on "House quarantine."

House quarantine during an epidemic.—Here, it seems to me, no elaborate or specially restrictive measures are advisable. Certainly in large towns, and with the epidemic well under way, none are practicable. To attempt too much is to fail and do less than if less were attempted.

The aim should be—

(1) To prevent infection of sick premises and to keep the other inmates from developing fever from such infection as we fail to prevent.

(2) To prevent unnecessary ingress of people in the sick room, or premises.

(3) To prevent conveyance of infection from sick premises to outsiders.

(4) To destroy, as far as possible, the focus (presumably) thus established.

Of these, the first, second, and the fourth are now the most important.

(1) The removal of unnecessary fabrics from the sick room, cleanliness, aeration and destruction or disinfection of the discharges are about all that can be done to prevent infection of premises. The isolation of the inmates from the sick room should be advised and the advantage of sleeping in the upper story remembered.

(2) The means which will prevent ingress varies with the respect for the law and the good sense of the community. In some places, as at Montgomery, Ala., an official prohibition and placarding is sufficient, and when this is not it is doubted if the measures which would be are advisable. In general, simply designating the houses and prohibiting entrance is all that to me seems advisable.

(3) Perfection here would be change of clothing, disinfection of hair,

etc., on the part of those leaving the house. Free egress would then be harmless. This can not, in general, be enforced, but the change of clothing should be recommended and ordered and will be followed to a considerable extent, and to that extent do good. There is less risk in even free unconditional egress than is generally believed.

(4) The premises should be disinfected with as much thoroughness as will not lead to such obstructive measures—concealment of cases—as would defeat our ends. Burning the certainly infected heavy bedding (soiled mattresses, etc.) and replacing it by new articles is not only good per se, but does much to make disinfection popular, and hence more general and efficient.

It was found last year that the disinfection of the person—required in some towns of all in the house—was more objected to than everything else and, save for the patient, I would not require this and would be satisfied with soap and water for him.

If an epidemic begins early in the season it may well be a question whether even the method here outlined, which works little inconvenience and no hardship, is worth attempting. An epidemic of yellow fever well scattered in a town will be apt to go through it.

The propositions presented for adoption in the above-quoted paper are also reproduced here for adoption.

(1) House quarantine may be an efficient means of suppressing the spread of yellow fever in a city.

(2) It may also be an efficient means of retarding its spread.

If used for the first purpose there being but few cases of yellow fever in the city,

(*a*) The nonimmune inmates of the patient's house should, if they remain in the city, be moved from that house immediately and kept under observation in an isolated place free from infection.

(*b*) The patient if not in a suitable place, and it be safe to move him, should be moved to one, and the premises disinfected.

(*c*) The premises the patient occupies should be under guard, prohibiting ingress and egress of persons, save as absolutely necessary and under sanitary supervision.

(*d*) Every possible precaution must be taken to prevent infection of his environment by the patient.

(*e*) Guards must be under sanitary surveillance.

(*f*) The premises of the patient should be thoroughly disinfected on death or recovery of the patient.

(*g*) That if the conditions be such that successful concealment of cases be caused by the measures adopted they must be so modified as to avoid this and such restrictions removed and privileges added as may be required.

If used for the second purpose, during an epidemic,

(*a*) Such precautions as are not too onerous should still be taken to prevent infection of premises of patient and inmates of his home.

(*b*) Ingress into the infected premises should be discouraged and unnecessary ingress forbidden.

(*c*) Egress from the infected premises should be freely allowed, with such precautions, as change of clothing, etc., as can be enforced.

(*d*) The premises should be disinfected on death or recovery of the patient.

(*e*) These measures are advisable in proportion to the lateness of the season.

DISINFECTION.

It seems better to put these few points on disinfection of premises by themselves. They really belong on page 73, "Premises," but to insert them there would, I think, break the continuity of the sketch. It is not proposed to give a description of the process, only to call attention to a few points not always noted.

A. The owner must be insured against any loss from disinfection. We must do no injury, or pay for what we do. If this be not done, it may lead to concealment of cases of fever or else to concealment of fabrics especially valued, which thus escape disinfection.

B. Unless the disinfector be experienced, it is well to do as much burning,* wetting and soaking in antiseptic solutions as possible, using gaseous disinfectants as adjuvants.

C. For gaseous disinfection the house must be close or must be made so. For thick fabrics—cotton quilts, mattresses, pillows, beds, etc.—gaseous disinfection can not be depended on, if more than their surfaces be infected.

For the disinfection of these articles steam is required, and, indeed, it is advisable to use this agent for all fabrics where attainable. Boiling, of course, is equally (absolutely) efficient, as soaking in an efficient germicidal solution. The writer would state that his observation leads him to have full faith in the use of sulphur dioxide if properly used; also, it has been his experience that this agent very rarely is properly used outside maritime quarantine stations. He has full faith, also, in the efficiency of the aeration of fabrics.

Prolonged exposure to sun and air, reasonably dry air, will disinfect any ordinary fabric from yellow fever as completely as burning, and if the choice be between gaseous disinfection as usually applied and aeration he would, by all odds, prefer the aeration. Of course the location of the premises is frequently such that aeration of infected fabrics is not possible. The house should be kept open, well ventilated, and dry after disinfection.

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* Not a few cases of development of fever has been ascribed to burning infected articles. Whether the current of air caused by the fire carries the agent of infection through the heat, etc., may be a question. If the surface of the pile be pretty thoroughly wetted with coal oil and this fired first, it would seem impossible that infection would be thus spread. The writer has no personal cognizance of any spread from burning infected articles.

D. The premises outside the houses must be made clear of trash—chips, leaves, pieces of board, etc., rotting wood being believed to be an especially bad nidus of infection. The mere wetting of these things as they lay with bichloride solution is not thorough disinfection, the underside seldom being reached by the solution.

It is an injury to wet the leaves of living plants with bichloride of mercury. It kills the leaves, etc., and after a rain has washed the bichloride off, these dead leaves are a good nidus (culture nudium) for any infection not destroyed, as on the underside of the leaf. It is not reasonable to believe that the living leaf would serve such an end.

E. The thorough wetting of the cleaned ground, ditches, etc., with bichloride solution or covering it with chloride of lime is doubtless efficient, but unquestionably the disinfection of the outside premises by fire is the method of election.

This is best done by the Barber asphalt furnace as used by Farrar in New Orleans in 1897, which is fairly manageable. If this machine is not available, ordinary fires built and continued for a considerable time, as done by the writer at Conquests Camp and at Brunswick, Ga., in 1893, is absolutely efficient but far less manageable and more apt to set neighboring structures afire.

The introduction of the asphalt furnace by Farrar is a distinct and valuable addition to our disinfecting armamentarium, and indeed is equivalent to giving a new and most efficient "method," for it renders quite generally applicable a method which was but rarely used by the crude means used in 1893.

By watching the houses to the leeward of the disinfected house one can sometimes form a fairly good idea of the efficiency of the work done about the premises, even if the nonimmunes do not return to those disinfected.

F. Disinfection, when we hope to suppress the fever, must be thorough. Everything must yield to this. The evil we seek to avert is too serious to weigh expense, or convenience, or hardship against it.

G. When we no longer hope to suppress the fever and use this measure simply to limit or lessen the rapidity of its spread the extent to which it should be carried out depends, as so many other quarantine measures, on the balance between the good to be attained and the cost, including hardship and inconvenience. In general, the fabrics of the sick room and nurses' room and these rooms themselves should at least be disinfected. This, if done by some method not injurious and little annoying—formaldehyde and steam, and scrubbing the floor with bichloride solution—will not make the second factor large, and will, I believe, in a considerable number of instances prevent the further infection of the household. No one who has examined the lists of the sick by houses, as in post-epidemic disinfection, can fail to be impressed with the fact that yellow fever is to a considerable extent a house disease, even during an epidemic.

MEASURES TO BE TAKEN IN A DISTRICT THREATENED BY YELLOW FEVER.

By Surg. H. R. Carter.

The measures to be taken in the district threatened by the yellow fever epidemic depends to a great degree on what is done in the infected district, including its immediate environment.

Perfect cordon impossible.

If a cordon absolutely perfect were around the infected district and the arrangements for mail, freight, express, and passengers were also perfect, nothing need be done by places in the threatened district any more than by the country at large with a good maritime system on account of an epidemic in Havana. It seldom or never happens that these conditions exist, and precautions to supplement imperfections in our first guard are requisite. It is well at first to determine on the limits (next to the infected town) of certainly clean territory. The district between this and the territory adjudged infected, or probably infected (the so-called "neutral zone"), requires special attention.

Neutral zone.

Before a cordon is established there is almost invariably an exodus into the country adjacent to an infected town, and after it is established there is especially at first a certain amount of seepage, so to speak, through the cordon. Also the district adjacent to a large town will probably elect to continue some direct communication with it, choosing rather to run a certain risk of infection than to interrupt their trade relations entirely. Unless this action unduly risks other communities, I think it is to be allowed. This communication, too, may be so guarded that the risk is minimal ("daylight communications," etc.), and yet these districts should not be considered for quarantine purposes as "certainly clean."

This region (neutral zone), of possible contamination, yet which we try to keep clean, is to be held as infected so far as communication with clean places is concerned and as clean with regard to that infected district. It should be subjected to frequent inspection, and it frequently happens that a district rendered suspicious by an early exodus of refugees may subsequently be pronounced clean.

Train inspection from South.

The local passenger trains running from the direction of the infected town should be inspected. This is because a certain number of people may come out even to considerable distance from the infected town or district in private conveyance and take the train in clean territory at way stations. A proper system of inspection and certificates of residence materially lessens this risk.

Inspection must begin at the starting point and go as far as these people are likely to travel by private conveyance. More than this is unnecessary. At some suitable place on each road a place for the temporary detention of suspects is to be established. They should be put off the train at this place and as soon as practicable sent back to the general camp of detention. It may be advisable, however, to make other disposition of these suspects. There is no need of inspectors meeting the train before coming to each city.

A main object of this inspection (of local passenger traffic) is as far as possible to prevent suspects getting on the train—that of the through passenger traffic to prevent them getting off in clean territory. The station agents of the railroads may be our most efficient assistants.

Trains from North.

Whether it be necessary to inspect trains from the North, to prevent the return of those who have gone North and not stayed long enough, may be a question. I think it is generally unnecessary and generally inefficient. On such trains, however, as have inspectors on them going North the inspection on the return trip should be done as an added precaution.

Uninfectible region South.

There is a section of highland, the southern end of the Appalachian mountain system, which projects into the South, into which refugees may safely be allowed to go, but from which, owing to its proximity and other causes, a train inspection should be maintained. In this district, especially in railroad centers like Atlanta, it is also well to keep as much supervision of the movements of refugees as possible, keeping their addresses, etc., for ten days.

The country adjacent to the infected district, having due regard to means of communication as well as distance, should be inspected thoroughly and often, and kept inspected. This is necessary both for its own safety and that of the country beyond. The inability to do this on account of unwise quarantine restrictions was, I think, one cause of the spread of the recent epidemic. It is also of the greatest commercial advantage in quieting rumors and allowing traffic to go on unimpeded, and if this work be done as a matter of routine the presence of the inspector will cause no alarm or excitement. This inspection of healthy places may be widely extended in territory having even well-guarded communication with the infected district with the greatest advantage.

Inspection of healthy towns.

In towns of considerable size it is well to have an inspector of freight and express to see that none is landed without proper certificate. It is a check on the work in the infected district.

Inspection of Freight.

Towns considered especially threatened by yellow fever should establish in some safe place a small isolation camp of both tents and buildings, where an important case of fever can be removed, if it be right to move him, and where those presumably exposed to his infection, or rather suspects, may be isolated. Time and risk of infection will be saved by having this ready.

Provisional isolation camps.

A place may be so isolated as to be in extreme danger of infection, generally by proximity, from an infected town. In this case all ingress must be subject to sanitary supervision and a cordon around the clean town may be required, and practically the same system be adopted as for a besieged city. By this method Kenner, La., 11 miles from New Orleans, received no infection in 1897.

Cordon arounp healthy towns.

MEASURES TO BE TAKEN IN AN INFECTED AND NONINFECTED TOWN.

By P. A. Surg. A. H. GLENNAN.

The experience of this year has tended to confirm my observations made at Key West, Fla., in 1887, where I gained some practical knowledge in the early stages of a yellow-fever outbreak. The first case was discovered in a large boarding house in a populous section of the city. Immediately upon the announcement of the disease these unacclimated boarders scattered to different parts of the city, and owing to defective sanitary and police powers they were kept under a desultory surveillance only. An immediate exodus of other unacclimated people took place, by every available means, to the neighboring keys and the mainland. This is the inevitable tendency in any community upon the announcement of the first cases of yellow fever, and the immediate steps to be taken are, first, the isolation of the sick, guarding the infected premises and contiguous blocks as well, and second, a systematic supervision over all persons and effects leaving such a city or town, with the least amount of hindrance compatible with safety.

ISOLATION OF INFECTED CASES.

In incorporated municipalities, infected premises are generally posted with a yellow flag, and a guard stationed at the front door. This is not sufficient. A cordon of guards—immunes if obtainable—should be established around the infected block and contiguous squares as well. These guards, when relieved from duty, should not be allowed to go to and return from different parts of the city, but should be maintained at some near central point. A captain of these guards should inspect the day and night watches at irregular times, prevent persons, vehicles, or street cars entering or departing through the lines, see that supplies and necessary articles are delivered at stated times and places, and also to arrest and return persons escaping through the lines. In addition to this, a house-to-house inspection of the infected area should be made once or twice daily by competent physicians, twice daily being preferable, as it tends to reassure the persons in the restricted district.

At the same time a systematic inspection and disinfection of premises, yards, and alleyways should be carried out.

This double guarding of first foci of infection is comparatively inexpensive and worthy of effort, even if unsuccessful by reason of the disease appearing outside of these lines. A result is obtained in a limited time, and the expense can be rapidly discontinued.

In Mobile this year yellow fever was confined for some weeks to twelve or fourteen contiguous blocks, belted by a street-car line only, which route it slowly traveled, although no systematic effort was made to restrict it to this belt. Special stress is to be laid upon the fact that guards should not wander about while off duty. A house guard upon night duty roamed the streets in the daytime, wearing his badge; I afterwards isolated and treated him with a severe case of yellow fever, although he had not entered the infected premises.

Interesting points also to be considered, both legal and sanitary, are the removal of the sick, and local depopulation of small infected areas, under proper precautions, to safe points for observation.

PASSENGER-TRAIN INSPECTION.

The few rudimentary rules laid down in the Report of the National Board of Health for 1879 are not adequate for the present rapid transit of passengers and movement of freight. The object to be attained is to ascertain that no person ill or suspected dangerous is allowed to depart from an infected city or town, and also that passengers are under surveillance while en route to destination.

I attained the first object this year at Mobile by stationing a competent physician at the union depot in that city, who personally examined all would be departing passengers and obtained a signed declaration of their residence, nonexposure to infection, and number of pieces of baggage. To this declaration was attached the inspector's certificate of examination of the bearer and disinfection of baggage. By an arrangement with the railroad companies box cars were located near by, for disinfection of baggage, railway mail, express packages, and other matter. Ordinary shipping tags were attached marked "Disinfected," signed, and stamped with the seal of the Marine Hospital Service. This baggage went through to all points without trouble, though I learned that baggage from other points was overhauled along the line.

The second object was attained by placing a competent physician upon each departing train, to examine the passengers en route, who were persons from New Orleans and the infected Gulf coast towns as well; memorandum slips were taken up, completed, certificates checked up and passed on at the next relay, the inspector taking the return train at the most convenient point. In this way a double-check service was instituted, and after I assumed direction of affairs not a single passenger developed yellow fever after leaving Mobile. In one instance a passenger purchased a ticket without first obtaining the certificate of inspection. He was detected upon the train and returned to the city by the inspector. The incident was not repeated by the ticket offices. In another case a prominent railroad official with his attending physician departed on passes without certificates and were captured by health authorities in another State and subjected to vexatious delay and disinfection.

Pullman sleeping and upholstered cars should be discontinued, except possibly upon through trains for the North. These, together with ordinary cars, should be treated with the steam air blast, disinfected at some central point, and a dated certificate of the fact attached to each car before it is allowed to return.

Relays of train crews should be made at not less than five miles from an infected city or town, and another preferably at the State line. It is not necessary to transfer the passengers into new coaches, the experience of this year showing that they are best detained for observation near their point of destination.

Train crews, when changed however, should be rigidly kept from mingling, both on freight and passenger trains, as my experience shows that these men, from their environments, offer greater danger along lines of travel than from any other source.

FREIGHT DISINFECTION.

The disinfection of freight and box cars is best performed outside the city limits, with due regard to its classification. Flat cars are not specially a source of danger, but if their external surfaces are required to be treated it is quickly done with a hand force pump, hose, and spray nozzle, from a barrel of bichloride solution swung upon a light wheel truck, which can be moved along the line of the train; this will also answer for disinfecting the interior of empty box cars. The work is more effective, cheaper, and timesaving, than by fumigation, to say nothing of the *absurd method of placing a sulphur pot upon the open track beneath a flat car, which I heard of in one or two instances.* This may be classed with the exploded theory of refrigerating freight in box cars, as a method of disinfection.

The cars should then be lead sealed and a red label pasted (not tacked) to the outside marked "inspected and disinfected," dated, and signed.

There is no necessity for transferring freight to new cars at any relay station.

Freight upon steamboats is preferably disinfected before being placed upon board, the vessel and the crew being inspected, and disinfection carried out where necessary. Only classified articles should be accepted; household goods, trunks, etc., rigidly excluded. If passengers are accepted at all upon steamers running to interior points, they should be carefully examined and their baggage disinfected, as in the case of passengers departing by train.

Highways and other outlets from an infected place should be guarded, possibly by the municipal and county officers, although a great amount of good is not to be expected from these city officers in the way of preventing friends and acquaintances from leaving an infected place, while they might be trustworthy in keeping out any threatened danger.

DISINFECTION OF THE MAIL.

Considerable delay and dissatisfaction was caused during the past season by rural communities refusing to accept mail matter from an infected place under any circumstances.

In my opinion, mail bags and mail matter from any infected city or town of considerable size should be disinfected with formaldehyde gas while en route. The mail matter and bags can be scattered and hung upon racks in the mail car, lamps or gas generators used, the car sealed and labeled, and the run made to the next general distributing point, where the matter can be sorted and sent back to points outside of the infected district. This method will effect a great saving of time and an assurance of security.

The wooden paddle, studded with nails to perforate letters, is a slow instrument of torture and delay, besides being ineffective, as it plugs the space between the hole of entrance and exit. If necessary, a hopper should be used, but it can probably be proven that the gas is sufficiently penetrating without these punctures.

DETENTION CAMPS.

While depopulation of an infected city or town is to be encouraged in every way by means of through trains to places not liable to progagate yellow fever and willing to receive the refugees under the supervision as already described, detention camps become necessary as filters of a certain portion of a population who are unable or unwilling to travel considerable distances, but who wish to proceed into the uninfected surrounding country, and would otherwise do so surreptitiously. The construction and arrangement of these camps is well known. They are here mentioned as a medium of communication between infected and noninfected places. There are a few points, however, which have developed in the experience of the past season, to which I wish to invite attention.

A. The location of a camp should be selected to avoid the possibility of being shut in between infected districts, and preferably near State lines. The distance in the transportation of refugees is of little importance as compared with a safe outlet, for there is no benefit in detaining refugees under observation to afterwards pass them into another infected place, even if it is to return to their homes.

B. The expense of wooden buildings can be avoided, dining and kitchen houses can be superseded by medium-sized circus tents, or a number of large wall tents lined together, with central larger tent for kitchen purposes, etc.

Light, portable disinfection rooms in sections can form a part of the camp equipage and be rapidly erected for the purposes intended.

C. The present heavy tent floors, in two sections, should be cut through into quarter pieces for less expensive handling and quicker transportation.

D. In addition to the mattresses furnished a quantity of bedticks should be provided, which can be filled with hay or straw at the camp location, and afterwards destroyed. This is a good idea, suggested to me by Steward Peck of this service.

If these equipments are organized in sections, heavy and bulky material dispensed with where possible, the establishment of a camp will be numbered in days instead of weeks. As soon as they have accomplished their purpose and ceased to be useful they are also more rapidly shifted, in sections, to other fields of usefulness.

MEASURES AT NONINFECTED PLACES.

The second part of your instructions, to state what precautions should be taken at uninfected places having communication with places which are infected, is complex and difficult. This is due to the fact that in several of the States (Florida excepted) individual counties, villages, and settlements are a law unto themselves as regards sanitary matters. Probate judges, mayors, and self-constituted village authorities proclaim a quarantine against the world. Trains are not allowed to pass through their territories under any regulations or at any rate of speed. The roads are tied up. Advantage is taken of the situation to twist commerce for selfish interests. To my knowledge the stock of liquors and provisions became exhausted in one of these places, and an offer was made to raise the quarantine for two days, obtain a fresh liquid supply, and close it down again. Over all this situation the State boards of health have only advisory powers, and their advice is often received with derision.

I have observed, however, that where a strict total nonintercourse was proclaimed the object has been signally defeated in time by the entrance of the disease. In some cases where mail was absolutely refused from an infected place it was sent to St. Louis and other points under cover for remailing.

Certain general procedures, however, may be outlined, following somewhat the rules laid down for departures from an infected city or town.

First. An inspection station should be located not less than 5 miles outside of the corporate limits, where passengers and baggage considered safe can be transferred and admitted upon a local train, other passengers and train crews being excluded, and to pass through at a speed of not less than 10 miles an hour.

Second. A camp of detention is of greater benefit near points of destination than if located just outside an infected district. Diversity of routes and mingling with other travelers are avoided after undergoing the period of observation, and greater confidence is given the pratique.

Third. The municipal police and county officers, in a noninfected place, display greater zeal in keeping out irregular communication by road and water ways or other means of entrance by circumvention.

Fourth. Mail matter should be received from the first distributing point of the postal service to the northward or outside the infected district with a general authoritative certificate of safety.

Fifth. Freight, express matter, and rolling stock if not already certified to as "inspected and disinfected," should be treated at the relay station outside the city limits before being admitted.

If a proper surveillance is maintained over the arrivals and the steps taken in a suspicious case, as indicated in the first measures for premises in an infected place, a greater degree of safety will be secured than if total nonintercourse is proclaimed.

MEASURES TO BE ADOPTED TO PREVENT THE PROPAGATION OF YELLOW FEVER FROM AN INFECTED TO A NONINFECTED LOCALITY.

By Asst. Surg. SEATON NORMAN.

Disposition of first case.

1. The patient should be isolated immediately and no intercourse allowed with healthy individuals. The persons exposed should be removed, if practicable, to a different house, or if the weather permits, to a tent provided for the purpose, and should be kept under observation for ten days. As soon as the patient recovers or dies, the mattresses, pillows, comforts, and blankets should be destroyed by fire or be thoroughly disinfected. The house and premises should then be subjected to thorough chemical disinfection and the apartments exposed to sunlight and free currents of air for several days.

The attending physician and nurse should, if possible, be immunes.

When more than one case occurs.

2. Should more than one case occur, or many foci be discovered, a cordon should be established around the town or village to control the egress or ingress of the people.

The advisability of depopulation will depend upon the size of the town or village, the density of the population, and the number exposed. Where a case has occurred, for instance, in an army post or in a crowded community, an immediate exodus and the subsequent detention of suspects will be the best method of exterminating the disease. In cities a cordon would not be considered practicable, and regulations governing the transportation of passengers, baggage, express, freight, and mails must be adopted.

Supervision of railroads.

3. The railroads issuing from, and the boats plying on the river from, an infected port should be under the strictest medical supervision. On the line of each railroad leading from the city there should be established, if practicable, a probation camp at a safe and convenient distance, where persons desiring to leave the infected locality may be detained for such a time as to insure their freedom from infection. Medical inspectors should be placed on each train, so that

Detention camps.

should any passenger develop symptoms of suspicious fever he may be isolated until a station is reached where he may leave the train. The isolation hospital of the probation camp would be the proper refuge for such a passenger.

Unrestricted northern exit.

Persons whose destination is north of the southern boundary of Maryland and who do not intend to return within ten days to a point quarantined against the infected territory, may be allowed to proceed. Arrangements should be made for the changing of train crews and railway-mail clerks at stations distant not less than 15 miles from the infected place. Changes should also be required at a point along the route 40 or 50 miles beyond the station where first change is made. Railway inspectors should accompany trains for at least 100 miles beyond any infected place.

Railroad inspection.

The crews and passengers of steamboats should be inspected immediately before their departure, and if the trips are of less than five days' duration, this inspection should be repeated on their return. Only two cases, I think, developed on the various steamers leaving New Orleans during the fall of 1897, and in both instances the vessels were immediately and thoroughly disinfected.

4. The express companies handled very little matter during the late epidemic, forwarding only such articles as required no disinfection.

Regulations of shipment of freight.

5. Freight for shipment should be divided into two grand classes: That requiring no disinfection and that capable of disinfection. A specified list of both classes should be placed in the hands of the freight agents of the various railroads.

During the past epidemic in the South such a classification was made by Surg. H. R. Carter, United States Marine Hospital Service, and his assistants' certificates were accepted by the entire South.

NOTE.—Free and uninterrupted daylight communication by rail and boat continued between New Orleans and Covington, La., during the past fall. Covington is a small summer resort, situated on Lake Pontchartrain, directly north of New Orleans, about two hours' journey from New Orleans, and no case of yellow fever was reported there during the late epidemic. If a case did occur there, the conditions favorable to its dissemination did not exist. A similar instance of the capriciousness of yellow fever is recorded by Dr. John P. Wall in the Annual Report of the Marine-Hospital Service, 1889, where uninterrupted communication existed between Seffner, Fla., and Tampa, Fla. Although a few persons in the incubative stage at the time of departure from Tampa developed the disease in Seffner, only 12 miles distant, the infection did not spread.

Intercourse also existed between Covington and Amite City, La., on the Illinois Central Railroad, although the latter place observed strict quarantine against New Orleans. As far as I know no yellow fever occurred in Amite City.

Disinfection of mails.

It is barely possible, not probable, that first-class mail matter may convey infection; old and soiled newspapers, coming from an infected house, would undoubtedly be a source of danger.

While it may be considered that the disinfection of mails is generally a useless labor and expense, clamor and fears of the public may render it necessary.

In the late epidemic in New Orleans, letters and single-wrapper newspapers were submitted to formaldehyde gas in a closed chamber specially constructed for the purpose, while newspapers were disinfected in a steam chamber designed by the service. Supplementary disinfection was also instituted at points farther north on the Louisville and Nashville and Illinois Central railroads.

Return of refugees to the infected district.

Refugees should not be permitted to return to the infected territory until after the second frost or until the place has been pronounced by the constituted authorities as free from fever.

MEASURES NECESSARY AT A HEALTHY LOCALITY TO PREVENT THE INTRODUCTION OF THE DISEASE.

Restrictions relative to persons.

No person from an infected territory should be allowed to enter a noninfected place unless he has complied with regulations relative to a probation of ten days' supervision and in addition to having his effects amply disinfected by the most approved methods. This rule should not apply to immunes, who should be allowed to proceed, provided their baggage and other effects have been subjected to thorough disinfection. Places north of the southern boundary of Maryland incur but a minimum risk in receiving refugees, and cities like Atlanta, which are elevated high above the sea level, may receive individuals from the infected district with comparative freedom from danger.

In the districts where it is known by experience that the disease if introduced will spread, absolute nonintercourse, if possible, should be observed. Even in such territory, communication, under the proper safeguards (such as detention at probation camps, disinfection of effects, etc.), may be permitted with safety.

REGULATION OF TRAFFIC TO, FROM, AND THROUGH YELLOW-FEVER-INFECTED TOWNS.

By P. A. Surg. J. H. White.

A.—Traffic from one clean place to another through an infected town.

(1) *Freight.*—In sealed cars, freight should pass without let or hindrance, but cars should not be allowed to remain in the infected town overnight.

(2) *Empties.*—Empty cars (box) should be passed through sealed, but not allowed stoppage. Flat cars can not become infected, or if so, simple cleaning would remove it, and hence it is a matter of indifference whether they stop or pass directly through.

(3) *Passengers and train crews.*—Passenger trains should be allowed passage through an infected town in daytime and under observation of inspectors, who should prevent any stoppage or any possible communication between any person on the train, crew or passenger, and any other person in the town. Especial care is needed where trains move slowly through a large city, offering opportunity for entry to and exit from them. Special watch must also be kept against tramps boarding trains under these conditions, and, indeed, under any other. Crews may require relay in case of a large city.

(4) *Mails.*—Through mails need no interference.

B.—Traffic from infected points to noninfectible points.

(1) *Disinfection of baggage and freight.*—To points North may be generally assumed to be unnecessary, provided ample assurance is obtained that such will not be returned South. Baggage, if there be any reason to doubt its remaining North, should be disinfected with the same care as that for points South. The freight charges would almost certainly bar any returning of merchandise (new). Household goods (old) should be watched more carefully and should be disinfected even if going North, unless late in autumn.

Express matter under same conditions as freight.

(2) *Empty cars going North.*—If going through without stop and left open as freely as possible (end windows as well as doors) to first relay

station and then doors closed, no reason for disinfecting, as the aeration so obtained is most thorough and fully as efficient as need be.

All cars, however, should be very thoroughly swept before starting. The latter is all that is needed for flat cars.

(3) *Passengers and train crews originating in an infected town and bound North.*—Such should from the beginning be under observation, and continue so until they reach a point beyond the infectible zone.

Each road should provide a relay for its train crews near to, but outside, the infected area, where crews should change and the train continue its journey with a crew beyond suspicion.

It would be very advisable when possible to have the relay who take the train in hand in clean country to be (at least the conductor and brakeman) immunes. Of course, this may be impossible.

A sanitary inspector (a doctor) should be constantly on each passenger train and be cognizant of the destination and state of health of each person on the train; should assure himself that they reach that destination, and be aware of their health status when they leave his observation there.

On the return trip, he should be empowered to forbid anyone starting who can not prove his recent whereabouts, and so avoid the doubling back of persons recently out of the infected place and trying to reach noninfected but infectible localities.

(4) *Mails going North, i. e., into noninfectible territory.*—Letter mails for points North need no disinfection; neither do newspapers.

Parcels will hardly need it, but in view of possible return South would best be either barred or disinfected; this may be modified by location of distributing points South. Railroad mails should have same supervision as other mail.

C.

(1) *Baggage and freight to points South, i. e., to infectible territory from infected points.*—All disinfection of these things may and should be done at point of origin, for same reasons given for mail matter, viz: Economizing officers and avoiding possible infection of the camp or other point selected outside for disinfection.

Of course, disinfection outside might be and probably is more certain, but the difficulty and expense incident to the creation and operation of an outside plant would be enormous, and in many cases impossible to overcome.

All merchandise should be classified in four separate groups, as follows:

(*a*) Such as may be shipped without any obstruction.

(*b*) Such as requires investigation and may or may not require disinfection.

(*c*) Such as must be always disinfected.

(*d*) Such as is absolutely barred shipment.

(I adopted such a classification in Hamburg in 1893, and found that the volume of actual inspection was much reduced thereby, and also that it did away with much unnecessary disinfection which was already being done, while insuring disinfection of articles needing it.)

In railroad work, of course, having no customs manifest as an absolute check upon the honest description of goods, we must inspect everything before shipment, but will avoid countless inquiries.

Express matter should be governed by same rules as ordinary freight.

Household goods should be debarred shipment to points South unless it be possible to disinfect perfectly (generally not the case in the great press of an epidemic).

(2) *Empty freight cars going South.*—These should be swept clean, and if going only a short distance, I would advise an interior surface disinfection with 1–1000 $HgCl_2$, which I did at Avondale, La., and in which manner an energetic crew with proper appliances can treat 200 cars per day at a cost of 25 cents per car.

Subsequently all ventilating windows to be left open until destination is reached, be it long or short.

Flat cars need no disinfection except such as ordinary sweeping clean will give.

(3) *Passengers from infected to Southern points.*—Passengers originating in infected towns and bound South should invariably (unless well-proved immunes) go into a camp of detention for at least eight days before being allowed to proceed. They should be under observation, if practicable, while en route to camp and before embarkation. Observation on embarkation has, in my own experience, discovered a few cases of yellow fever, and to that extent relieved the camp of some cases by their being returned to their homes or to hospitals.

No health certificates to nonimmunes should under any condition issue from any infected point, and all officers should be forbidden to give any certificate of nonexposure to infection to any person resident in a city or town resting under even a faint suspicion, for the reason that, while theoretically correct, my experience goes to show that one can not definitely determine nonexposure.

(4) *Mails for points South.*—Letters pure and simple need no disinfection. Newspapers, if originating in a very badly infected quarter, should have the usual manner of steam disinfection; otherwise not disinfected at all.

Parcels should be debarred absolutely as possible carriers of disease and involving an amount of labor to disinfect beyond the good derived from same.

If disinfection must be done, it can be and should be done in town of origin, because disinfection in town of origin economizes officers and avoids the possible infection of another point, i. e., the mail camp.

Puncture of mail should be made with a knife, which should make slits—the nail punctures close up—or, better, have properly punctured envelopes on sale.

COMMUNICATION WITH AN INFECTED TOWN.

By Surg. H. R. Carter.

It must be noted that an infected town is a source of danger to its neighbors, whether communication be allowed with it or not, because a certain amount of illicit and unwatched communication will occur, especially if the season be prolonged, no matter what is allowed. In my experience the rigid nonintercourse rule was, if to be kept up for considerable periods, less safe than carefully regulated commerce. I mean as a general rule. The object then is to formulate general rules under which commerce through and from infected places can be carried on first with the greatest safety to other communities, and second, with the least inconvenience. The measures to be taken to some extent vary from a sanitary standpoint with the degree of infection of the place and from a commercial one with the interests involved and the way these interests are involved. The problem, even considering only the risk of conveying infection, which naturally is the first consideration, is of extreme intricacy, and only a general outline to be varied in particular cases can be given here.

A.—RAILROAD TRAFFIC THROUGH AN INFECTED TOWN.

(1) *Freight.*—Freight traffic in sealed cars passing through such a town needs no regulation; it is safe.

(2) *Empties.*—The same is true of empty freight cars, but care should be taken to see that they do not contain tramps, etc. Neither freight nor empties should stop—i. e., stay in the town.

(3) *Passengers.*—Can pass through such a town by adopting the most obvious precautions—not stopping in town, not communicating with it in any way. Closing the cars is in general unnecessary, but is easy to do and is an added safeguard.

(4) *Train crews* are under the same general rules as passengers. Under some conditions they may require relay. The traffic through such a town must be under the supervision of a sanitary inspector.

(5) *Mail cars.*—To be handled like passenger coaches.

B.—RAILROAD TRAFFIC FROM AN INFECTED TOWN.

Through traffic, i. e., to points incapable of receiving yellow-fever infection, to be designated hereafter as points north, the places capable of receiving infection being designated as points south.

(1) *Freight.*—Freight of any usual kind in sealed cars can go without hindrance through to destination.

Freight cars which are ventilated passing to points north were, however, disinfected (bichloride 1–500) at New Orleans to pass through Southern territory, and I believe this to be advisable.

(2) *Empties.*—Cars, clean, need no disinfection. Box cars, clean and dry and closed, are incapable of conveying infection. If open, the same is, I believe, true, especially if not parked open in a specially infected place. They must be carefully inspected for tramps.

(3) *Mail.*—Is under the same rule as other freight, modified by the location of distributing points. Parcels other than mercantile sample packages shall be barred. It is an easy problem. Railroad mail is also to be attended to.

(4) *Passengers.*—Traffic to points north can be allowed by preventing all chance of such passengers conveying infection en route, either by themselves leaving the train, returning to points south, or by fomites; mainly their clothing.

Now, as a rule people travel in clean clothes and are well when they start. The risk from the clothes which they have on, while it exists, is not great. The risk from a case of yellow fever developing en route is practically nil if ordinary precautions be taken, as it takes some days—three is probably the minimum—for such a case to infect his environment. Besides, experience has shown that such cases seldom occur.

This traffic should be on a special train, which should not carry other passengers. A sanitary inspector must accompany this train beyond the quarantined territory, under whose absolute sanitary charge the train is, and who will prevent communication by persons or possible fomites with this territory, and carry out other sanitary regulations. It is best that these men, especially the first relay of them, be physicians and immunes. The coaches which carry these passengers must be disinfected before they come South again. Unless they stand some time in the infected town, which they should not, there is no need to disinfect them there.

Before these people are allowed to go North, we must be assured that they will remain there to cover the period of incubation of yellow fever (say ten days) or indefinitely, i. e., after frost.

Disinfection of baggage is not necessary for the latter. If, however, they will return after a time to points South, their baggage must be disinfected on departure. Indeed, if there be any reasonable doubt of their not returning, the burden of proof being on them, disinfection of baggage must be done.

The methods by which the train inspector, on whom this work falls, assures himself (1) that a passenger intends and will stay North indefinitely, and (2) that he will stay ten days and not double back, must be worked out for each particular epidemic, and to a certain extent to each particular road and case. A good man will err by oversuspicion and hard rulings.

Train inspectors must inspect return trains returning to the infected town for those passengers returning to points South. Train inspectors must be properly relayed and the first tier of them ought to be immune. If they sleep in clean territory, they must be.

C.—LOCAL TRAFFIC, I. E., TRAFFIC TO POINTS CAPABLE OF BECOMING INFECTED BY YELLOW FEVER, I. E., POINTS SOUTH.

(1) *Freight.*—This traffic must be limited to such articles as will not convey infection, whether by nature, as railroad iron; by origin and history, as original packages in smooth metal containers, put up in clean locality or by disinfection.

(It will be further limited by what will be received.)

The division of freights promulgated by the Marine-Hospital Service this year in New Orleans, and adopted with slight modification by many State and municipal boards, is not a bad one. It was decidedly incomplete, however, and does not contain all that it could contain, either in the class requiring no disinfection or in that shipable with disinfection. Still, it contained nothing that was not strictly safe if shipped under its provisions and was found practicable and smooth in its operation. A better one can be devised after consultation with merchants, railroad men, and health officers, but it is rather an extensive job.

Express matter must be counted as freight. It is infinitely more troublesome.

Empties.—Under the same rules as in B. Box cars should be opened, not closed. If going a short distance, they may be disinfected; it is very little trouble. If a considerable one this is unnecessary. The chance of conveying infection for even a short way by a clean, dry, empty box car is minimal, if it exists.

The time they stay in the town and the locality in which parked, if parked, is to be considered.

Mail.—In general, mail can be disinfected as well in town as at a station outside of the infected district. There may possibly be occasions, however, when the latter method is preferable. I never saw one, but can conceive of them.

Newspapers have little chance to become infected, but if they do might retain and convey it. If in large amount steam is the only practicable method.

Packages are best not allowed in the mail.

Letters do not require disinfection; the Havana mail has never been and is not now disinfected.

On the chance of envelopes containing fomites it may be judged best to disinfect letter mail, but most of such can be discovered in the necessary handling, and I believe the added safety does not compensate for the inconvenience.

The best way is to have properly perforated envelopes on sale, as at Brunswick, Ga., and to refuse all not in such envelopes, and use formaldehyde for the disinfecting agent. The ordinary punctured envelope, however, does unquestionably admit gas to its interior, and its use is efficient, though bungling. Steam is not applicable to letters.

Railroad mail must be disinfected just as any other.

Passenger traffic.—Direct passenger traffic from an infected town to points capable of receiving infection must not be allowed. Those certainly immune may go to such territory without detention after disinfection of baggage. Personal disinfection, unless in very special cases, as of those recently attending the sick or disinfecting goods or premises, is unnecessary.

The others must pass a period sufficient to cover the period of incubation of yellow fever, not exposed to any infection during this period, before being allowed to enter this territory. This is the theory of the detention camp. The details of the camp are not to be considered here.

People who have gone to points North to spend their period of incubation are in the same position as those who have been through a detention camp. The baggage of these people must be disinfected before leaving, and it is best to count the period of detention from arrival at their Northern destination, as there is a possibility (although extremely slight) of contracting fever from possible fomites on the train, just as that in camp counts from disinfection of personal wearing apparel.

Relays.—All train crews, freight and passenger, in traffic from an infected town, must be changed so as not to go into clean territory. This should be done at a place as isolated as possible, a siding rather than a station, and certainly not in a town.

Every man, mail agent, expressman, and train butcher (news agent) must make this relay, unless we know that he is going North not to return to points South, in which case he is like a through passenger.

None of the merchandise of the train, butcher, unless disinfected papers be excepted, must pass the relay. No possible fomites must pass the relay to the crew bound North, and as little communication as possible, save what is necessary for the run of the train, is allowed. The relay must be under the supervision of a sanitary officer or officers (two are generally required), whose position is one of great responsibility.

The camps for the north and south crews should be at a considerable distance from each other, and the run of trains should be arranged so as to have the crews in camp as little as possible. For passenger trains there need be no delay; for freight trains generally there must be, and their crews go in camp. There is no necessity of doubling these stations if suitable ones be chosen and they be well conducted, but conditions may be such, as on the Illinois Central and Yazoo Valley Railroad this year, where it is advisable.

These stations must be frequently and carefully inspected, and the same is true of the train inspection work.

Occasions may arise where it is necessary to guard the southern relay camp by a number of guards, as if it were a camp of detention. It must never be allowed to become infected.

A PRÉCIS OF DETENTION CAMP MANAGEMENT.

By P. A. Surg. J. H. White.

Although instructed to prepare this syllabus of detention camp management simply with a view to yellow fever, the writer has presumed to so arrange it that with slight changes it may also meet the requirements of other diseases.

Of course it would be possible to go more deeply into details in many directions, but it has been shown by the past experience of this service that competent officers do better work when furnished with outline rules rather than minute instructions. The smaller details will suggest themselves when the outline is given. The mind is able to take a comprehensive glance of the whole general plan given in outline, while if it be padded with minutiæ this desirable result is in a measure prevented.

DETENTION CAMPS.

To avoid any confusion as to meaning, it may not be amiss to state that this whole article will, in the body thereof, refer entirely to camps for yellow-fever purposes, and that the necessary deviations to meet the requirements of other diseases will be treated in a final chapter.

LOCATION OF CAMPS.

In the selection of a site for a camp of detention, the general points to be considered are:

First. A healthful location, as free from malaria as may be available and a situation which has good natural drainage. The avoidance of any possibility of standing water after heavy rains is essential, because such camps are frequently to be occupied by delicate women and children, whose health and comfort are both to be watched over.

Second. A site so situated as to be easy of access by rail or steamboat and very preferably the former.

Third. One to which good water supply and a good base of food supply is easily accessible.

The camp should consist of two distinct portions: (1) main camp and (2) hospital camp. The whole establishment should be, if possible, at a distance of a mile or more from any settlement. The adjunct camp for yellow fever and intermediate hospital purposes should be at least one-fourth mile to leeward or one-half mile to windward of this main camp.

The location should be as close to the infected place as clean territory, suitable for the purpose, can be found. It should preferably be upon a line of railway, whose distributing or dividing point outside is a small place rather than a large city. While this matter of small distributing point is not absolutely essential, it is advantageous, as enabling the easy and careful observation of the distributing point, which point is the one most likely to be attacked in the event of any accidental escape of infection from the camp.

Camp Perry, located by P. A. Surg. John Guiteras, United States Marine-Hospital Service, in 1888, on St. Marys River, where it is crossed by the Savannah, Florida and Western Railroad, about halfway between Jacksonville, Fla., and Waycross, Ga., on a slightly rolling sandy plain, which drained itself rapidly into the river, was an ideal location. It also fulfilled the above-mentioned requirement, Waycross, the distributing point, being only a village of about 3,000 inhabitants.

EQUIPMENT.

The site having been selected, the ground should be prepared by such slight ditching as may be necessary to prevent any standing water in case of heavy rains. Much ditching should be avoided on account of malaria. It is always advisable to provide the hospital camp complete before any other work is done, as it often occurs that the very first admissions bring suspected cases to light.

Experience has shown that the general outline of establishment used at Camp Perry, subsequently modified by a board of officers (Surgeon Carter and P. A. Surg. Kinyoun), is the most convenient form.

It consists of a hollow square, of which the buildings form one side and tents three. Subjoined are ground plans, which are believed to embody all the needed changes from the plans of Drs. Carter and Kinyoun. An alternative, ground plans of which are also submitted, presents itself here, viz:

A double camp, its two parts independent, except for a common executive office and kitchen (although not always feasible), presents the advantage that seldom or never will there be any suspicion attached to Camp No. 2, because, as a rule, nearly all sickness has, in our experience, developed within the first four days, and hence would be developed in the Camp No. 1. This plan of a double camp would naturally inspire in the people outside more confidence in the safety of camps, and, although not at all a sanitary necessity, may be expedient, for its moral effect alone. Such double camps should be divided, not only by guards, but by a double fence of barbed wire as well. The whole of both camps should be surrounded by a double barbed-wire fence, at least 6 feet in height, each fence to have wires 6 inches apart, from top to bottom, and the two fences set 18 inches apart, so as to render egress in haste a matter of physical impossibility. All refugees in the main camp should be housed in tents, in order that disinfection may be easy after any suspicious case has occurred. Kitchen and dining rooms should be arranged so as to involve a minimum of time and labor in serving meals, and with capacity in the latter for seating the whole number of refugees at one time. For purposes of good discipline, there should be provided separate tables for subaltern officers, such as commissary, quartermaster, clerks, et al., in order that they may the better preserve their proper authority over attendants; officers of the guard may be included in the list of such officers, or the whole guard messed together, according to circumstances. It is not at all advisable that the guard, however, should mess with the lower grade of attendants, as the responsible nature of guard duty is prima facie evidence of the necessity for a better class of men for these important posts, and they should therefore be separated when possible.

In addition to the privies located on the plans there may be necessity for providing a few, more convenient of access, for delicate women, and these should by all means be dry earth closets located in a tent, and daily emptied. The locations indicated in the plan should not be considered as essential, but should be varied to avoid contamination of the water supply or for other sanitary reasons.

If not already existent, a sufficient amount of railroad siding should be provided to hold the necessary cars for disinfection and commissary purposes. At a point most convenient for this purpose on this siding there should be built a waiting and dressing pavilion, containing from four to six rooms, to be used for the purpose hereinbefore mentioned, and from four to six tents, end to end, for examination, reception, and registration of applicants for admission.

In case it be deemed advisable to use the double camp heretofore recommended, the only necessary change in the plan submitted, and labeled "Exhibit A" will be the placing of the buildings laid down on said plan exactly in the center of the quadrangular open space and the running of a barbed-wire fence through the middle of the camp from side to side, in such manner that the line occupied by said fence shall bisect the site of the surgeon's office, the telegraph office, the kitchen, and the commissary.

It will also be necessary to provide in this case an additional quartermaster's storeroom unless the existing storeroom is also placed upon the middle line, which can in fact be done by making one building serve for quartermaster's and commissary's work.

It is believed that there will be no necessity for changing the entrance to camp in the substitution of a double for a single camp. Should such change, however, be considered necessary, it may be readily accomplished by leaving out a sufficient number of tents from the camp on the side next to the surgeon's office to provide a 50-foot avenue from the surgeon's office to the outside and running the wire fence in this case, so far as it concerns that portion fronting the surgeon's office, as two fences, one being on either side of the aforesaid avenue.

FOOD AND WATER SUPPLIES.

If pure water can be obtained by pumping or carrying from a neighboring stream, such supply is preferred, and only when this is unavail able should resort to driven wells be had. In case neither of the above supplies are available, water should be brought in railroad water cars from some reliable source; and in very porous soils, where water is near the surface, the driven-well supply should be a dernier resort, as it is manifest that in a small territory the dejecta from 1,000 persons, no matter how carefully removed, must to some extent poison such water.

The food supply should come by preference from a noninfected city or town, but in some cases, as at Camp Fontainbleau, in 1897, it is absolutely impossible to do otherwise than obtain supplies from an infected center. In such cases all containers must be either at once burned or disinfected, preferably burned. Sawdust, paper, cloth, etc., so used should be burned at once.

PERSONNEL.

In addition to the commanding officer, the medical staff, and the hospital steward, the necessary personnel of a detention camp should be:

(A) Guards, who should be placed at intervals, long or short, according to the topography of the site, and be under officers to be named hereafter.

(B) Disinfecting force.

(C) Quartermaster, commissary, clerks, bugler, telegraph operator.

(D) Cooks, waiters, laundresses, scavengers, teamsters.

ROUTINE, DISCIPLINE, ETC.

The commandant should make frequent day inspections of camp and guard lines, and occasional night visits to the latter; visit at frequent intervals all parts of the camp, and in general so inform himself as to be capable of deciding, in large measure from his own knowledge, the complaints brought before him. He should see without exception all cases of sickness, however trivial, reported by the inspectors, and himself decide whether suspicious or not. He should not confine himself, however, to routine inspections, but leave such to his assistants. He should keep careful watch against possible bad food or polluted water as tending to create sickness which may simulate yellow fever and confuse diagnosis. The assistant medical staff, consisting of one or more inspectors, in proportion to the size of camp, one resident physician for the hospital, and one doctor or chemist as chief disinfector, should each and all report directly to the commanding officer. A double daily inspection at 9 a. m. and 4.30 p. m. is absolutely essential for the discovery in their incipiency of suspicious cases and should include each and every soul in camp—guests, officers, and employees—and in the event of there being any resident population near the camp, even though a quarter mile distant, these also should be inspected at intervals of a few days. The duties of the steward should consist in the supervision of the classes stated in article on personnel, sections C and D, the buying of rations, supervision of accounts, and other such duties as by the regulations of the Marine-Hospital Service appertain to his office.

SANITARY POLICING OF THE CAMP.

All refuse should be removed each day from all streets and tents, and promptly burned. All privies should be daily scrubbed clean, and the dejecta covered thickly with a mixture of copperas and lime, which is an excellent deodorant. Dejecta should be carted away and buried every week. Kitchen garbage, very apt to accumulate, can best be disposed of to pigs outside the camp, or failing this, be buried also outside the camp. A special force of one or more scavengers, in proportion to size of camp, must be detailed for this work of cleansing camp, and the steward should exercise most careful supervision over their work.

Especial care should be used to detect and prevent the commission of nuisances in the camp streets at night, a thing which is extremely difficult to compass, on account of the hoodlum element often present. A liberal use of the guardhouse with a diet of bread and water is the best remedy, but even this is not absolutely effective.

As an adjuvant to the thorough cleansing of camps and the disinfection of grounds, it is advisable to provide one or more of the furnaces used by the paving companies in melting asphaltum. These furnaces may be used to sear the ground under and around a tent, which has become infected, and even for destruction of dejecta removed from privies.

HOSPITAL.

The hospital camp, as before stated, should be at a distance from the main camp and under the same isolation from outside communication. It should consist of, preferably, 8 small wooden buildings and about 12 tents, namely, 4 hospitals capable of containing 2 patients each, 1 kitchen and storeroom, 1 small house for resident physician, and 2 small privies, 6 tents for suspects at a distance of 100 yards to windward of the hospital tents, and from 4 to 6 tents for guards and attendants. The whole camp should be surrounded by a double barbed-wire fence, as in the main camp, and under guard night and day. Communication should be carried on with the main camp by only two means: (1) A telephone, when obtainable; (2) a wagon for supplies and for ambulance purposes, which wagon should be driven by an immune and sprayed with bichloride of mercury solution (1–2,000) whenever used for any infectious material. The grounds of this camp should be policed with the same thoroughness as the main camp. An outer guard should patrol this camp and allow no person within 200 yards of the wire fence surrounding it, and especially to leeward of it.

An endeavor should be made to prevent the infection of the hospitals themselves or at least to minimize such infection. This end may be best attained by the immediate disinfection of all articles of clothing and bedding as fast as such are removed from the persons of patients, and by the admission of fresh air and sunshine to the hospitals whenever the weather will permit. All dejecta must be disinfected, as soon as passed. All disinfections to be done as provided in the quarantine regulations of the United States Treasury Department.

It is imperatively necessary to prevent the infection of the tents used as an intermediate camp or hospital for merely suspicious cases, and to this end all such tents should, in addition to the precautions named above, be washed down with 1-2000 solution of bichloride of mercury after each occupancy, and the floors removed and ground beneath and around them burned by a Barber asphalt furnace, the floors to be wetted on both sides with 1-1000 solution of bichloride of mercury, If all this is done promptly and thoroughly, this most important part of the camp may be kept free from infection indefinitely.

Nurses and other attendants attached to this intermediate hospital should be immune, for it must be borne in mind that these patients are all at least suspicious, and many of them may ultimately find their way into the yellow-fever hospital near by. It goes, therefore, without further saying, that all officers, guards, nurses, and attendants in hospital or intermediate camp must or should be immune to the disease treated in these camps. There should, however, be no mingling allowed between these two hospitals for fear of infecting some suspect who really has not yellow fever. All cases which have been positively diagnosed should be removed at the earliest possible moment to hospital if yellow fever, or to camp if not.

RECEPTION AND TREATMENT OF GUESTS.

All persons seeking admission to a camp should be given a permit by some responsible agent in the infected center, and such permits in any one day should in no case equal more than one-eighth of the total capacity of the camp. Upon the arrival of a refugee at camp he should be at once examined as to his health by one of the inspecting officers detailed for that purpose, and if found not to be suffering from any suspicious disease he may be registered. He should then turn in his effects for disinfection and await in a building provided for this purpose the return of his disinfected belongings. He should then change his clothing and submit for disinfection the suit worn upon arrival. This being completed, he may finally be admitted to the main camp, and no further disinfection required, unless he subsequently develop disease in his own person. It is advisable that invariable rules should obtain in all camps, and, as nearly as may be, all persons treated exactly alike and concessions made to none.

The hours for rising in the morning, for meals, for inspections, for retiring, and for lights out should be sounded by a bugler at set hours each day. At inspection each and all guests should present themselves at the front of their tents, and be required to remain there until the completion of the inspection, thus avoiding the confusion incident to their being allowed to move about after being themselves inspected, with the consequent result that one man is inspected twice and another not at all. No sickness can be considered too trivial for a careful investigation, and any case presenting symptoms in the faintest degree suspicious should be at once isolated. The attention of the commanding officer should be called at once to all cases.

SUBALTERN OFFICERS AND EMPLOYEES.

All employees other than guards and disinfectors should report directly to the steward, if in marine-hospital camp, or to the corresponding official in other camps. These should be (1) a quartermaster, whose duties are to provide outfits for each tent or building, to see to the keeping of the same in repair, and to prevent the abuse or theft of property; (2) a commissary, to receive and issue stores and keep the records appertaining thereto, and to perform such other duties as the steward may direct; (3) a sufficient number of clerks to keep record of entry and discharge of guests and their belongings; (4) a telegraph operator; (5) necessary cooks, laundresses, waiters, and scavengers in proportion to the number of occupants of the camp.

The disinfecting force should be under the charge of a competent and experienced man, preferably a physician or chemist, and the number of his assistants sufficient to handle all the effects of guests promptly and carefully.

The guard should consist of from 25 to 40 men, who should be selected with the greatest care possible, as on their fidelity and courage depends more than on any other force, the successful issue of the camp. It is advisable to select first two sergeants for night and day duty respectively, and ultimately as the men become better known to the commanding officer, four more, and finally from these six, the captains of the guard, the permanent officers for night and day command can be carefully selected. The guard should be divided into watches of preferably eight hours' duration, though the length of the watch may well be either four or six hours. They should patrol the outer line of the camps night and day, allowing no one to pass in or out, who can not give the proper countersign. The countersign should each day be provided by the commanding officer. In addition to outside patrol, guards should patrol the avenues, between tents, during the night to prevent noises or nuisances. All guards should report to the captain of their respective watches, and the captains to the commanding officer, anything unusual occurring under their observation.

ADJUSTMENT TO DISEASES OTHER THAN YELLOW FEVER.

In the application of the foregoing chapters to the management of a camp for cholera or smallpox, the changes to be made are as follows:

For cholera, the food and water supply must without exception come from an absolutely noninfected locality, and no possible variation can be made from this rule. The camp need not be so far from the nearest settlement, and greater pains must be taken to disinfect or destroy dejecta. The period of incubation being short, the detention after last possible infection need be only for five days.

For smallpox, the food and water supply demand no greater attention than in yellow fever. The camp need not be at any great distance from the nearest settlement. The dejecta disinfection is of no moment except as to general sanitation. The period of incubation demands at least fourteen days' detention.

SUGGESTIONS AS TO BUILDINGS, LIGHTING, AND HEATING.

Buildings are most quickly constructed with perpendicular rough planking for weatherboarding, covering cracks with 1 by 3 inch strips and roofed with tarred paper. These buildings are generally for summer use and therefore such construction is ordinarily sufficiently weatherproof. Should heat be necessary, stoves may be used with ease. It is advisable to elevate all buildings on blocks, to a sufficient height to allow free circulation beneath. Wire netting may be stretched around the base of buildings to keep out animals and refuse.

Posts should be provided for lamps at regular intervals, to light the camp streets. These lights, preferably regular kerosene-burning street lamps, serve a good purpose in preventing nuisances at night by creating publicity.

It sometimes becomes necessary to provide heat, even in a camp for yellow fever, and in such case it is well to build a large shelter with an opening in the center of the roof. Open fires may be lighted under this opening for the comfort of guests.

All such fires should be in the central portions of the grounds, and no fire allowed in the camp streets under any conditions, as such fires are very likely to result in destruction of the camp.

DISINFECTION (ADOPTED FROM REGULATIONS).

The following methods of disinfection are considered efficient:

FOR YELLOW FEVER.

(1) Apartments or dwellings infected with yellow fever to be disinfected by one or more of the following methods:

(*a*) By a thorough washing of all surfaces of apartments with an efficient germicidal solution.

(*b*) By sulphur dioxide for twenty-four hours' exposure, 4 pounds of sulphur for each 1,000 cubic feet, plus due allowance made for waste.

(*c*) By formaldehyde gas in not less than a 4 per cent per volume strength, and not less than six hours' exposure.

NOTE.—One liter of 40 per cent solution of formaldehyde gas will evolve about 1,425 liters (50.1 cubic feet) of gas at 20° C. (68 F.).

(2) Grounds, outbuildings, etc., deemed to be infected, to be disinfected with a strong solution of crude carbolic acid (carbolic acid, crude, 2 parts; sulphuric acid, 1 part; water, 25 parts) or an acid solution of bichloride of mercury (1–500); disinfection of ground preferably by fire.

(3) Bedding, wearing apparel, carpets, upholstered furniture, and the like to be disinfected by one or more of the following methods:

(*a*) By steam at a temperature of 100° to 102° C., thirty minutes' exposure.

(*b*) By boiling, all parts of the articles to be submerged.

(*c*) By saturation in an efficient germicidal solution.

(*d*) By thoroughly wetting the surfaces of articles with a 40 per cent aqueous solution of formaldehyde, and placing them in a closed space for not less than twelve hours.

(*e*) Where surface disinfection is required, formaldehyde gas of not less than a 4 per cent per volume strength and not less than six hours' exposure, or by sulphur dioxide for not less than twenty-four hours.

(4) The dejecta from cases of yellow fever to be disinfected by an efficient germicidal solution.

Mails to be disinfected by one of the following methods:

(*a*) By formaldehyde.

(*b*) By sulphur dioxide.

(*c*) By steam.

(Newspapers must be made up in such packages as shall be penetrable to the disinfectant used.)

FOR CHOLERA.

(1) Dejecta and vomited matters of cholera patients shall be received into vessels containing an acid solution of bichloride of mercury (bichloride of mercury, 1 part; hydrochloric acid, 2 parts; water, 1,000 parts), or other efficient germicidal agents of equal value.

(2) Bedding, clothing, and wearing apparel soiled by discharges of cholera patients, or used by them or in their care or treatment, shall be disinfected by one or more of the following methods:

(*a*) By steam at a temperature of 100–102 C., thirty minutes' exposure.

(*b*) By boiling, all parts of the articles to be submerged.

(*c*) By saturation with an efficient germicidal solution.

(3) Woodwork or furniture contaminated by cholera discharges shall be disinfected by thorough washing with an efficient germicidal solution.

(4) Clothing and personal effects suspected of being infected with cholera shall be disinfected by one or more of the following methods:

(*a*) By steam at 100° to 102° C., thirty minutes' exposure.

(*b*) By boiling, all parts of the articles to be submerged.

(*c*) By saturation with an efficient germicidal solution.

(*d*) By wetting all surfaces of the suspected article with an aqueous solution of formaldehyde gas, and placing it in a closed space for not less than twelve hours. Containers may be disinfected by wetting all surfaces with an efficient germicidal solution and allowing it to dry.

Where only surface disinfection is required:

(*e*) By formaldehyde gas in not less than 4 per cent per volume strength and not less than six hours' exposure.

(5) Apartments known to be, or suspected of being, infected with cholera shall be disinfected.

(*a*) Washing all surfaces with an efficient germicidal solution.

(*b*) By formaldehyde gas in not less than 4 per cent per volume strength, and for not less than six hours' exposure.

FOR SMALLPOX.

(1) Apartments infected with smallpox shall be disinfected by one or more of the following methods:

(*a*) By exposure to sulphur dioxide for twenty-four hours, 4 pounds of sulphur for each 1,000 cubic feet, plus due allowance made for waste.

(*b*) By exposure to formaldehyde gas in not less than 4 per cent per volume strength, and for not less than six hours' exposure.

(*c*) Washing all the surfaces of the apartment with a solution of an efficient germicide.

(2) Clothing, bedding, carpets, articles of furniture and the like, exposed to the infection of smallpox, to be disinfected by one or more of the following methods:

(*a*) By exposure to steam at a temperature of 100° to 102° C. thirty minutes.

(*b*) By boiling, the articles to be completely submerged.

(*c*) By saturation with an efficient germicidal solution.

(*d*) By thoroughly wetting the surfaces of the article with a 40 per cent aqueous solution of formaldehyde, and confining it in a closed space for not less than twelve hours.

(*e*) By exposure to formaldehyde gas in not less than 4 per cent per volume strength, and not less than six hours' exposure.

(*f*) By exposure to sulphur dioxide for twenty-four hours.

MISCELLANEOUS.

Articles injured by steam, such as rubber, leather and containers, to which disinfection by steam is inapplicable, to be disinfected:

(*a*) By thoroughly wetting all surfaces with an efficient germicidal solution, the articles being allowed to dry.

(*b*) By exposure to sulphur dioxide.

(*c*) By exposure to formaldehyde gas.

The application of gaseous disinfection to these articles should be made in a closed space, air-tight, or as nearly so as possible.

The following are considered efficient germicides:

(1) Bichloride of mercury acid, 1–1000.

(2) Carbolic acid, pure, 5 per cent solution.

(3) Trikresol, 2 per cent solution.

(4) Solution of formaldehyde, 1–500 (which is 1 part of a 40 per cent solution of formaldehyde to 199 parts of water).

(5) Solutions of hypochlorite of calcium (chloride of lime).

CAMPS OF OBSERVATION.

Inasmuch as it often becomes necessary to remove from trains or other vehicles while still within infectible territory certain persons not properly vouched for, it is probably advisable to establish camps at State lines, on railway routes, or at other strategic points.

Such camps are nothing more nor less than small detention camps, with a capacity for 25 to 50 occupants, and should be conducted on the same lines as detention camps. It will not be necessary, as a rule, to establish such camps, and never except at such points as are at too great distance from the regular detention camp for easy access, or too far from noninfectible territory to allow of transportation to such territory of the suspected persons.

TRAIN-INSPECTION SERVICE.

By P. A. Surg. G. B. YOUNG.

PREAMBLE.

In conducting a system of train inspection for the purpose of preventing the spread of disease and of facilitating intercourse and trade as far as is consistent with safety, it is most important to always keep in mind that the limitation of the spread of the disease should be paramount to every other consideration, the facilitating of traffic being of only secondary importance.

I lay stress upon this because my own experience has taught me that it is often difficult to maintain the proper point of view in the face of the senseless and vexatious oppositions of local origin that often upset one's carefully considered plans. One is apt to become absorbed in the task of opening lines, moving trains, and the like unless careful to remember that such things, while unquestionably of great importance for the public good, are not the most important part of the work.

RELATIVE IMPORTANCE OF QUARANTINE AND TRAFFIC.

I do not mean to belittle the importance of opening up traffic, however, for the suffering and loss that accompany the interruption of trade and travel during the presence of yellow fever, and the resulting local quarantines, are among the most dreadful consequences of the scourge.

Next to preventing the actual spread of the disease the most important thing to do is to strive to minimize the distress that the fear of its coming brings to all within the threatened territory.

In conducting a system of train inspection, then, our first duty is to facilitate in all proper ways the escape from infected places into noninfectible territory of those who desire to go; second, to supervise the movement from place to place in infectible, but clean territory, of those whose necessities compel them to travel; and, finally, to do what we can toward keeping open the channels of trade.

Let us consider the principles that should govern our action in securing each of these several ends, and then take up, somewhat in detail, the methods to be followed in maintaining these principles.

Under the first head, then, the rule can be laid down that all persons can be permitted to leave infected for noninfectible territory if a reasonable certainty can be secured that they will not return into infectible territory before the expiration of ten days from the last possible exposure to infection, which, however, may be and often is a very different thing from ten days since their departure from an infected place; but that this movement must be so conducted that no danger results to the territory through which they pass en route.

ALL PERSONS MUST GIVE SANITARY HISTORY OF THEMSELVES.

Under the second head the fundamental principle is that only those should be permitted to travel who can give a good sanitary history; and that while en route they shall be preserved from contact with any infected or suspected person, place, or thing.

Given the observance of these principles as to *both persons and things* and the opening of the channels of trade would seem to follow as a natural corollary, but on account of the peculiar conditions which arise under local quarantines it does not naturally do so.

For the proper opening of trade it is necessary, first to secure the confidence of the various local authorities and, second, to maintain sanitary control of the transfer and junction points, the "strategic points" in our sanitary campaign.

FORMULATION OF DETAILED RULES AND DESIGNATIONS FOR CLASSES OF PERSONS AND THINGS.

An attempt will now be made to formulate somewhat detailed rules for the conduct of a system of train-inspection service.

For the purpose of brevity the name "suspects" will be applied to persons from infected territory and that of "passengers" to those from uninfected territory.

Where mail, freight, or express cars are referred to they will be called "cars," passenger cars being spoken of as "coaches."

"Train crew" will refer to all persons employed on the train in any capacity, except that in some instances, to be noted at the time, the Pullman conductor and porter are treated as belonging to a slightly different class.

PASSENGER TRAFFIC FROM OR THROUGH INFECTED TERRITORY.

I. THE PREPARATION AND HANDLING OF TRAINS.

(*a*) Where the trains are made up in infected territory and subsequently run through clean territory.

CLASS OF COACHES PREFERRED.

Wherever possible, the coaches used in conveying passengers from or through infected territory should be of the kind equipped with cane seats. These are much less apt to become infected and are much easier to clean. No matting should be allowed in the central aisle and, as far as possible, all curtains and hangings should be prohibited.

WHERE TO DISINFECT COACHES.

Wherever possible, coaches used for carrying suspects should be disinfected at the ends of their runs, i. e., in clean territory.

This disinfection can be done by the employees of the road, but should be under the supervision of a sanitary inspector, who should be informed by wire on the departure of each train from the infected place of the numbers of the suspect coaches, and after disinfection the coaches should be placarded with the date of disinfection and the signature of the inspector.

RETURN OF COACHES EMPTY.

Where this can not be done the coaches should be locked and returned to the infected place and disinfected there.

Indeed, in some cases it will be best to return the coaches empty, even after disinfecting, for if the territory traversed is badly panic-stricken it will greatly help in alleviating the anxiety of the passengers if they know they are in no danger of being put into coaches recently vacated by suspects.

In this, as in many other things, it is often advisable to concede something to popular prejudice, so long as efficiency does not suffer thereby, or too great a multiplication of regulations does not result.

OBSTACLES TO RETURNING EMPTY NONDISINFECTED COACHES.

Theoretically it would be proper to lock these coaches and attach them to the rear of the train while returning them to the infected territory, so that the train crew could move freely about from car to car of the coaches in use without entering the reserved cars, but practically this presents many difficulties. Railroad men, like other men to whom the established routine has all the force of law, are exceedingly adverse to changing their methods or habits, and while we should, if necessary, utterly disregard their preconceived ideas of what should be done, we should at the same time avoid imposing rules that, while correct in the abstract, do not involve a vital necessity.

It is to be understood that I am referring above to lines on which the cars go through to points beyond the danger line, the case of branches and of local lines on which the coaches stand over in the infectible territory is somewhat different. Here, while the danger is very slight, we can not say positively that it does not exist, so it is best to have these cars disinfected at their lay-over places, if it can be done without causing alarm. I think it will be found, however, that the disinfection of cars at a small junction point, or even in a small city, will tend to make people uneasy, and possibly lead to the exclusion of trains. From an administrative point of view it is easier to disinfect at the infected place, because there we will be doing a great deal of similar work and will have the plant and force for the purpose, and, moreover, the men on the outside would be relieved from keeping up disinfection work at a number of points, the number rapidly increasing as the distance from the infected place becomes greater.

PULLMAN SLEEPING CARS.

Sleeping cars are in a different class from day coaches and need different treatment. In one sense they are more apt to get infected, as they are much harder to clean, contain much more infectible material, and moreover, being occupied at night on at least half the trains, they are very much more apt to have cases of fever develop in them.

On the other hand, they are more carefully looked after than the other coaches and are practically always "through" to noninfectible territory. Sleepers are very difficult and troublesome things to disinfect. The best thing to do with them usually is to require that a sleeper that has made a trip into an infected place shall not be returned into infectible territory until, say, ten days have elapsed—amply sufficient to make them safe.

SLEEPING CARS TO BE REGISTERED AND WATCHED.

A register should be kept at the infected place of all sleepers leaving it, in order to prevent them being sent out over one line and returned over another.

DISINFECTION OF BAGGAGE, MAIL, AND EXPRESS CARS.

Baggage, mail, and express cars should be disinfected immediately prior to their departure from the infected place, because, as they are to receive only disinfected baggage, mail, and express, and will be occupied after traversing the short distance to the relay station by clean crews, they are not a source of danger to the places at which they may lie over.

SOME BAGGAGE TO HAVE CONTAINERS DISINFECTED.

The only flaw in this is when undisinfected baggage "for points in noninfectible territory, there to remain," is being handled, and this can be met by disinfecting the outside of the containers. We now come to the consideration of the handling of the trains as a whole.

REFUGEE TRAINS BEST RUN THROUGH TO NONINFECTIBLE TERRITORY.

Unquestionably, where it is possible, and it will seldom be impossible, the trains bearing refugees should run through without making any stops except for coal and water. The refugee train can run as a section of the regular train, and thus disarrange the routine of the road's business as little as possible.

In the very few cases where this is impracticable the coaches and baggage cars used for refugees and their baggage should be absolutely reserved from other passengers and baggage. This does not necessarily apply to the express and mail cars, since they have been disinfected and receive only disinfected material, whereas the baggage cars may contain baggage "for noninfectible territory, there to remain," that has not been disinfected.

TRAIN CREW.

The entire train crew should be changed at the relay station to be described hereafter. This applies to conductor, brakemen, engine crew, baggage man, express messengers and mail clerks.

As the relay station is only a short distance from the point of departure, this need not seriously interfere with the handling of mail and express. The Pullman crew is best relayed too, but if the terminus of their run is far outside of the danger line they may be treated as indicated for the Pullman coaches—allowed to proceed, but not allowed to come back. This was the method followed to some extent last fall on the New Orleans-Chicago run, and as far as I am aware no trouble arose from it. The train boy must either be suppressed or else made to lie over outside of infected territory, and prohibited from drawing any supplies therefrom.

"SHUTTLE" TRAINS.

A method which I followed to some extent at Memphis in 1897, and which presents some administrative advantages over the one just outlined, is to have the refugee train made up at the relay station, and then run a "shuttle train" back and forth between the infected train and the relay station, transferring everything there to clean cars and coaches.

This works especially well when the distance between infected and noninfectible territory is short, as was the case between Memphis and middle Tennessee.

ADVANTAGES GAINED BY "SHUTTLE" TRAINS.

One possible advantage in this method is that the officer in charge of the inspection service can have direct control of all the inspectors and follow their work from the beginning of their runs, while otherwise the first tier of them has of necessity to report to the officer in the infected place, thus increasing his responsibility and labors, and at the same time causing a division of authority that might diminish the effectiveness of the service.

WHERE SECTIONS ARE TO BE MADE UP.

Which ever method is adopted, the section which is to do the local business in neutral or clean territory must be made up either at the relay station or, which is preferable, further out.

When separate trains are not used the refugee coaches are handled precisely as if they made up a separate train.

(*b*) When trains originate in infected territory and subsequently run through other infected territory, separated by zones of clean territory.

The way to meet this is to have the suspect section make all the infected stops, while the clean section makes the others. Should one of the infected places happen to be an important junction point great difficulties may arise. In such cases, however, it will usually be possible to arrange an immediate transfer, but how this is to be done, as well as the methods to be pursued when only separate coaches are used for suspects, come more directly under the head of actual inspection work and will be treated in that connection.

(*c*) When trains originate in clean territory and pass through infected places.

In this case the mechanism is simpler, it being understood, of course, that I am referring to places of too small size to justify the running of refugee trains, or so situated that it is impracticable. This latter condition will sometimes occur on account of the difficulty in securing a site for relay stations.

TRAIN SHOULD NOT STOP IN THE INFECTED TOWN.

The train should not stop at the infected place, but should pick up the refugee coaches at some point outside the town, even if only a few hundred yards, and the necessary couplings and setting of switches must be done by employes other than the train crew.

ARRANGEMENTS FOR SMALL PLACES.

For the use of small places or of larger places similarly situated; a combination coach and baggage car should be provided, and this coach, as in all "special coach" methods, should be attached to the rear of the train.

ARRANGEMENTS FOR LARGE PLACES.

If the place is of considerable size, so that the train has to reduce speed very much in running through it, there is always a danger of tramps and others boarding the train while in motion; consequently, in such cases, we must have the train stopped at designated points on either side of the town while a search is made for such intruders.

(*d*) Lines running entirely through clean territory but connecting with lines from or through infected places.

A conspicuous instance of this class in the fall of 1897 was the Memphis and Charleston Railroad. Running from Memphis to Chattanooga, it was cut at intervals by all the lines from the South. We accordingly had to cover it from end to end to prevent our flanks from being turned.

PASSENGERS FROM COLLATERAL AND CROSS LINES.

The "side drift" along such lines does not usually amount to very much, and all that is needed is such control that we can be sure that no one actually sick boards the train, and that all the trains are under such supervision as to prevent suspects from disembarking in infectible territory. As all the lines from suspected or infected territory are to be under guard, the chances of any harm coming from travel along these cross lines is very slight.

REASONS FOR INSPECTING CROSS LINES.

The main reason for inspecting these cross lines is that by so doing we can keep all the possible lines of travel under supervision, or at least control the travel, without actually inspecting every train. In the territory near the Alabama-Mississippi-Tennessee line, for example, there are a number of short branches which connect points in the two former States with points in the latter; but none of them extend south of the Kansas City, Memphis and Birmingham, very few of them south of the Memphis and Charleston. In 1897 we did not patrol these lines because the patrol on the east and west lines made it impossible that anyone could reach the north and south branches.

There is nothing particular to be said about the crews of trains ot these last two classes, except that of course they should not be changed at an infected place.

II. RELAY STATIONS.

These are the points at which the crews of trains coming from infected places are changed.

This is usually done only when the infected place is the starting point of the train, as in the case of New Orleans or Mobile, or where the infected zone lies along a definite section of road near the starting point, as along the coast of Mississippi Sound.

BEST SITUATION FOR RELAY STATIONS.

The relay station had best be at an isolated siding—should be there, in fact—but if this is not possible, then the most readily isolated station should be chosen. The distance from the infected place depends upon circumstances. Facility for isolation and control is a more important factor than distance from point of departure.

Wherever situated, the relay station must be under absolute control, and an inspector should be on duty night and day, with sufficient guards always at hand to enforce his orders.

The ideal condition is to have the relay made at the meeting point of the in and out trains, the crews simply exchanging trains; but this is seldom possible.

ALTERNATIVE METHODS.

There remain two other methods. In one the crew of the out train lays over at the relay camp to take in the next incoming train; in the other the main train is made up at the relay camp and there is a "shuttle train" that runs back and forth between the infected place and the relay station. As already stated, the latter method is far and away the best. It simplifies the administration of all the work—of trains, crews, and all. The disinfected mail, express, and baggage are transferred to the clean cars and handled by clean crews. All persons are also transferred to clean coaches, and in this way all the difficulty about Pullmans, etc., is avoided. If the trains are disinfected under this method, it can be readily done at the relay station.

RELAY CAMPS.

At such a relay there should be a camp for the train crews, and the inspector should have absolute control of it. The camp should be arranged in an orderly manner. It should be carefully policed, and all possible pains taken to keep it in good sanitary condition.

As this camp must necessarily be in "neutral territory," the greatest care must be taken to prevent any infection of either the camp or the surrounding country. No amount of pains is too great to take to prevent the infection of the camp.

If the relay is, as it should be, at an isolated siding, it may not be necessary to guard the camp; otherwise it should be closely guarded. Railroad men are especially intolerant of restraint, so there must be a clear understanding with the officials of the road that any disobedience of the inspector's orders means dismissal. This and the exercise of a little judgment at the start will soon get things to running satisfactorily.

CIRCUMSTANCES INCREASE DIFFICULTIES.

Should the circumstances compel the adoption of the method in which the out crew lays over to take the incoming train back to town, the difficulty will be vastly increased. It will then be best to have two camps, with attendant doubling of the guards, as it is necessary to prevent not only communication between the crews but communication between the inner crew and the country. In operating under this method the in crew brings the train to a stop at a point between the two camps and leaves it there and returns to its camp, while the outer crew then boards the train and takes charge of it. For incoming trains the process is reversed.

In one case I did about the same thing near Memphis, by stationing a caboose at a way siding and designating a point some half mile away as the transfer point. A switch engine preceded the train and took siding at the transfer point. When the train came in sight, the "outside" crew walked down to the transfer point and boarded the train, while the inside crew boarded the switch engine and returned to the city.

A QUARTERS TRAIN IS ADVANTAGEOUS.

If there is sufficient siding room a "quarters train" offers some advantages over a camp, especially in that if it gets infected, or is suspected, we can move it bodily to uninfectible territory and get rid of watching a fresh focus, and can then replace it with a clean train and crew and continue business at the old stand.

TRANSFERENCE OF FOMITES A GRAVE DANGER.

The greatest care must be taken to prevent the transference of possible fomites from the infected place to the relay station, and all transfers of passengers and crews should be under the personal supervision of the inspector.

HOSPITAL CAR OR ISOLATION TENT.

At all relay camps either a hospital car or an isolated tent should be provided for the care of any sick suspects that may turn up. A box car is the best; and another car should be at hand with an autoclave and supply of formaline for disinfecting purposes; this latter car should be without end windows, should be provided with racks of wire netting, have one door sealed and the other fitted with a canvas or rubber gasket, and have connections fitted through door so as to admit of the use of either formaldehyde or steam from a locomotive.

III. MANAGEMENT OF INSPECTIONS.

ORGANIZATION AT INSIDE END.

Necessarily the inner end of any system of inspection from infected to clean territory must be in different hands from the outer end and the organization of it is embraced in the management of the local work, and as such need not be especially described here beyond what has already been said. How far the jurisdiction of the inside man should extend depends on how far the relay is from the infected place, and more especially on how it is operated.

If a "shuttle train" is used the care of the relay should be in the hands of the outside man. If an exchange of trains is made this should also be the case, but if the crews both lay over it is best for the inside man to have charge. If there are two camps the line may be drawn midway between the camps.

ORGANIZATION ON THE OUTSIDE.

This much being settled, we come to the organization of the outside territory. As the country in which we are to operate is practically confined to the extreme Southern States, with the addition of western Tennessee and Arkansas, it is possible to study it in advance and get a clear idea of the routes of travel, junction points, and the like.

The scope of this article does not admit of going into the question of train connections, meeting points, etc. Everyone in charge of such work must work out the details for himself, and he will be apt to find it a troublesome job, but the main points of the work may be glanced at, as they play a considerable part in shaping the plan of organization.

STRATEGIC DIVISION OF TERRITORY.

Looking at the map, then, it will be seen that the roads in the "infectible territory" naturally arrange themselves into three groups. This is exclusive of the roads west of the Mississippi, especially of those in Texas. One group radiates from Memphis and Fulton, Ky., and may be called the western group, another occupies the center of the field with Nashville as a base, and the remaining group is made up of the lines converging on Atlanta and Chattanooga.

PROPER DIVISIONS FACILITATE THE WORK.

This arrangement facilitates the division of the work, but I am strongly of the opinion that the whole territory should be under one man. In no other way can the unity of control be maintained. We have to start off by dividing authority to some extent with the inside man, and further division increases the chance of confusion in a geometrical progression. It is a large territory of course, but I managed to cover about three-fourths of it fairly well last fall, and if a sufficient number of regular officers were supplied to take the subordinate divisions of the territory it would be much easier.

TERRITORY WEST OF THE MISSISSIPPI.

The territory west of the Mississippi should be divided. Arkansas naturally falls into the Memphis district for the most part, but Louisiana and Texas should be separate jurisdictions. The headquarters for the former should be at Shreveport and for the latter at Houston and Texarkana.

TERRITORY EAST OF MISSISSIPPI RIVER.

Assuming then that the work east of the Mississippi is to be under one head, he should have an officer to assign to the charge of each of the main divisions, with as many regular officers as possible under them and a sufficient corps of acting assistants and inspectors

The Memphis section being the most important, the general headquarters should be there. Of course these remarks are based on the supposition that it is the Southwest that is infected. If it is in some other section that the work is to be done the geographical remarks just made will not apply, but the general plan of organization will be applicable anywhere.

The headquarters should be adequately provided with clerical and other assistance.

It is idle to try to run a large inspection service without adequate office force. I tried to do so on the ground of economy, but it cost more than it came to. Whoever takes charge of such work will find that the impression in the minds of the general public is that "all knowledge and all power" have been intrusted to the "marine doctor," and that as a consequence he will be approached by hundreds of people with whose business he has no direct concern, yet whom he must either see or have someone see for him, and whose numberless letters of inquiry most be answered.

ARRANGE WITH HEADS OF RAILROADS AT FIRST.

Arrangements must be made with all the roads in the territory to furnish transportation for all officers and inspectors, and to issue orders to all employees that the train inspectors are in absolute control of all sanitary matters on trains and that their orders must be obeyed to the letter.

Provided one goes to the head officers to make arrangements he will find it a pretty general rule that the larger the corporation the more intelligent will be its cooperation in his work.

A clear understanding must be promptly reached with the express companies and with the superintendent of the Railway Mail Service and with the Pullman Company as to just what you want them to do. In all such cases treat only with the man at the top; it will save some trouble and a great deal of time.

TIME IS OF PRICELESS VALUE AT BEGINNING.

Time is of priceless value at the beginning. If it is a question of losing time or having misunderstandings with local authorities and railroads, act first and straighten things out afterwards; it is surprising how much you can do without any real authority if you insist on having your own way.

A competent steward should be in charge of the central office, and, if the territory is a large one, a stenographer and typewriter.

DIVISION CHIEFS.

The officer in charge should be free to go and come unfettered by office work, vouchers, and correspondence.

The chief in each district should have charge of all matters in that territory; receive the reports of inspectors, run over the lines himself pretty frequently, and at the same time cooperate, under the direction of his chief, with those in charge of the other districts. He should report direct to the man in charge of all the work, and take orders from him as far as concerns his immediate sphere of action.

OFFICER IN GENERAL CHARGE.

The officer in general charge should outline the work for each district chief, leaving the details very largely to them, but holding them to a strict accountability. He should visit all parts of his territory from time to time, investigate all rumors of the presence of disease, and transmit frequent reports of the work to the Surgeon-General, provided he can find the time. He should keep in close and cordial touch with the local health authorities everywhere, and with the heads of the transportation companies. The former are often a trifle suspicious at first, but tact and judgment usually overcome this very readily. It is often best to request as a favor what one could demand as a right. The people in the smaller Southern towns can usually be reasoned with—they are rather hard to force. The railroad people are generally eager to give every assistance, and their earnest cooperation is most essential. The discipline of a good road is of the greatest help when enlisted on our side. Generally speaking, the larger the corporation and the higher the rank of the official approached the more intelligent will be the assistance secured.

CHIEF OFFICER SHOULD KEEP INFORMED OF ALL WORK.

While the details of the work in each district may be left to the man in charge there, the chief should keep himself intimately informed of everything concerning the work in hand. In this work success depends on the execution of details; attention to details is really of rather more importance than excellence of general plan.

TRAIN INSPECTORS AND WHAT THEY SHOULD BE.

The inspectors should always be physicians. They should be furnished with plainly written instructions as to their duties, with formal credentials and badges, and if possible should be sworn in as deputy United States marshals.

MUCH AUTHORITY NEEDED BY INSPECTORS.

It will greatly facilitate the control of the train crews if each inspector is furnished with a letter from the general superintendent of the road, addressed to all employees of the road, and stating that the inspector is in absolute control of the train. A similar letter from the Pullman authorities should be furnished them, and they should have keys to all cars. They must be instructed that in case they find a case of suspicious illness on their train they will be expected to stay by it and to accompany it to one of the observation camps, mentioned in Section V, Chapter II.

CAMPS OF OBSERVATION.

These camps should be small, consisting of a couple of tents properly equipped with cots, etc., and in charge of two reliable men, and established at several points, the location of which can only be determined on the ground. These camps are for the care of cases of suspicious sickness that may be found on the trains.

IMMUNITY DESIRABLE IN INSPECTORS.

The first tier of inspectors—those under the jurisdiction of the officer inside the infected place—should be immunes. Immunity is desirable but not essential in the others.

SCHEDULES OF INSPECTOR'S DUTIES.

A schedule must be prepared showing what each man's duties are, what train he takes, where he transfers, etc. At the central office it should be possible, by consulting this table, to tell just where each man is at a given time, as the train dispatcher locates his trains from his "train sheet."

Such a schedule may prove a more difficult job than it looks, for suitable inspectors can not always be found in sufficient numbers, and those found must sometimes sleep and eat; and, moreover, stations, sidings, State lines, etc., can not be moved at pleasure, so it may be rather a puzzle to fit the men to the runs.

As an illustration of such difficulties and how they are to be met, I give the schedule on the Nashville, Chattanooga and St. Louis Railroad last fall.

The trains were worked out of Nashville into the quarantined territory west of the Tennessee River. Some trains ran all the way into Memphis, some part of the way, and some, after entering the quarantined territory, merged their identity in trains on other roads that entered that territory from other points.

On some of the return runs the men could sleep in the Pullmans; on others they had to work both ways.

Schedule for Nashville, Chattanooga and St. Louis Railroad between Nashville, Memphis, and McKenzie.

Train number.	Departures.	Time.	Arrivals.	Time.	Runs and location of inspectors.													
					Date.													
					1st.	2d.	3d.	4th.	5th.	6th.	7th.	8th.	9th.	10th.	11th.	12th.	13th.	14th.
4	Nashville	7.00 a. m.	McKenzie	11.25 a. m.	1	8	7	6	5	4	3	2	1	8	7	6	5	4
61	McKenzie	2.05 p. m.	Nashville	6.20 p. m.														
60	Nashville	9.40 a. m.	McKenzie	2.31 p. m.	2	1	8	7	6	5	4	3	2	1	8	7	6	5
3	McKenzie	3.40 p. m.	Nashville	7.55 p. m.														
60–2s	Nashville	9.40 a. m.	Memphis	7.00 p. m.	3	2	1	8	7	6	5	4	3	2	1	8	7	6
101	Memphis	9.30 p. m.	Nashville	8.00 a. m.														
62	Nashville	4.00 p. m.	McKenzie	8.41 p. m.	4	3	2	1	8	7	6	5	4	3	2	1	8	7
1–1s	McKenzie	3.35 a. m.	Nashville	8.00 a. m.														
2–1s	Nashville	8.45 p. m.	McKenzie	1.20 a. m.	5	4	3	2	1	8	7	6	5	4	3	2	1	8
1–2s	McKenzie	3.35 a. m.	Nashville	8.00 a. m.														
2–2s	Nashville	9.00 p. m.	Memphis	7.00 a. m.	6, 7	5, 6	4, 5	3, 4	2, 3	1, 2	8, 1	7, 8	6, 7	5, 6	4, 5	3, 4	2, 3	1, 2
53	Memphis	2.15 p. m.	Nashville	11.25 p. m.														

Each inspector to receive a number from 1 to 8 and take his run in accordance with the positions of said number on this sheet.
1s means first section; 2s means second section.

DUTIES OF INSPECTORS.

At the beginning it must be explained that the special details of inspection duty will vary very widely on different roads and under different circumstances. In the first place the regulations of the State and local boards will greatly modify the action we must take, and, as a rule, greatly limit our usefulness. I am assuming now that the law under which the work will be done will be as at present.

TO KEEP INFORMED OF LOCAL REGULATIONS.

The inspectors must keep track of all the changes in the local regulations, or at least the officer in charge must; he must also keep track of the way the local authorities construe the State regulations, and if they propose to be bound by them. Very often they do not.

TO LEARN STATE LINES AND LOCAL GEOGRAPHY.

If the line on which the inspector works runs through more than one State, the inspector must lose no time in learning the location of State lines, otherwise he will have to consult a map or the brakeman before he can answer a passenger's inquiry as to his status, which rather impairs his prestige.

THESE RULES ARE ON BASIS OF NATIONAL QUARANTINE REGULATIONS.

It being understood then that no hard and fast rule can be laid down as to the action under State rules, I will outline how the inspector should work in order to simply carry out the national regulations, and will begin with the case in which the infected territory surrounds the road's terminus, or at least the place where the trains are made up.

INSPECTORS TO BE ON HAND AT DEPARTURE OF EACH TRAIN.

An immune inspector, acting under the orders of the officer in local command, will be on hand before the departure of the train to see that all regulations as to the character of coaches, etc., have been complied with. On boarding the train he will carefully inspect everyone, from the engineer down, for even if all hands are relayed at the end of a few miles it is most important that none of the crew be allowed to sicken, lest they infect the transfer station. The sanitary condition of the cars must be looked into, and if the cars on that run are being disinfected or placarded he must see that the disinfection has been properly certified to and that the placards are in place. Either the inspector himself or another man detailed for that duty must see that no undisinfected baggage or express matter for infectible terrritory is put on board. He will then proceed to make a careful examination of all the passengers, ascertaining their recent whereabouts and their destinations. He will enter the names, etc., on the blank here given:

Report of United States sanitary inspector.

[Train No. ——; railroad, —— ——.]

No.	Name.	Origin.	Destination.	Certificate issued at—	Date.	Remarks.

These forms should be furnished in book form and be used with carbon paper between the sheets, so as to preserve a record after the original has been torn out and given to the next inspector.

TRANSFER OF LISTS AT RELAY STATIONS.

On arrival at the relay station he will assist the inspector stationed there to supervise the exchange of crews. He will then examine the new crew and enter their names on his report.

If the train is a refugee train and runs straight through, his duties will be confined to seeing that no one either leaves or enters the train at the points where stops have to be made for orders or for water and coal. He will keep the doors locked, allow no passing to and fro between cars, and rigidly restrict the intercourse of the crew with the passengers. When the train stops in a town, or has to run very slowly, he will have all the windows kept closed, not to prevent the conveyance of infection, but to limit the chance of communication. Should a case of suspicious sickness occur, he must promptly isolate the patient, and his belongings and companions, and wire the facts to his own chief and to the chief of the inspectors into whose district he is running. The ultimate disposition of the patient depends upon the circumstances of the case. Generally speaking it is better to carry him on into noninfectible territory.

IN CASE OF REFUGEES IN SEPARATE COACHES.

If the run is one upon which the refugees are in separate coaches of a train, doing local work, the inspector must see that there is absolutely no intercourse between the different classes of passengers and that the reserved coaches are kept locked at all times and their windows closed while passing through or stopping at all stations. He will carefully examine all persons boarding the train and require them to present satisfactory evidence as to their recent whereabouts. If possible this should be done before the person is admitted to the train; indeed it ought to be always done that way. Persons who can not give a satisfactory account of themselves should not be allowed to board unless holding tickets for points in noninfectible territory. Reaching the point where the in and out bound trains meet, the inspector will transfer to the inbound train, after delivering to the man who has come in on that train a copy of his passenger list, and given him all the necessary information about the train and the passengers. His list should include the crew and every person who has boarded the train up to that time. It will greatly facilitate the work if the agents are forbidden to sell tickets to those without papers.

"INSIDE" MEN AND "OUTSIDE" MEN.

The inspector who comes down on the inbound train, hereafter to be designated the "outside man," will transfer to the outbound train and proceed to check up the passengers with the list furnished him. On the way down he will have made a similar list of his passengers for delivery to the "inside man." He will also have carefully inquired into the recent whereabouts of all who are on board the train. Neither he nor the inside man should allow anyone to leave unless satisfied as to their antecedents. Of course it is not necessary for the doors and windows of the inbound train to be locked, but it is necessary that no one should enter or leave the train except by the permission of the inspector.

PURELY REFUGEE TRAINS WITHOUT LOCAL BUSINESS.

Of course in the case of a purely refugee train the outside man simply continues the supervision kept up by the inside man, and accompanies the train back to the starting point of his run.

TRANSFERS OF PASSENGERS TO OTHER LINES.

The outside man maintains the restrictions then until he reaches the starting point of his run, at which place the passengers are either allowed to proceed without further supervision or are turned over to the next inspector with the list received from the inside man, with the additions made since the transfer. This last list can usually be omitted as far as the purely local passengers are concerned. For instance, there is no use in making a list of the purely local people coming into Memphis over the Illinois Central. The inspector through whose hands the list passes should note on it the disposal of each passenger, whether he went on through, or transferred to another line, etc. All the way along, the inspectors should note on the report if passengers were received from branches or intersecting lines.

Where such transfers are made, a list of the names, etc., of those transferred should be furnished the inspector on lines to which they go.

ULTIMATE DISPOSITION OF PASSENGER LISTS.

At the conclusion of the run the report, bearing the checks and notes of the various men through whose hands it passes, is filed at the central office, and should be preserved there as a means of checking up the movements of individuals whose previous whereabouts may be called in question.

The receipt and filing of these reports should not be allowed to become a purely routine matter.

EVASION OF RESTRICTIONS BY DETOURS.

Of course it is impossible to prevent individual cases of evasion, but the people who take much trouble to evade the restrictions by making detours involving several days' travel are really not a source of much danger.

DUTIES OF INSPECTORS ON "SHUTTLE" TRAINS.

When a "shuttle train" is used between the infected place and the relay station, the man in charge of it does not have time to list the refugees; he merely has a general supervision of them, sees that none are actually sick, that all are delivered to the inspector who takes out the train from the relay station, and should also see that the coaches of the train are kept in good sanitary condition.

LINES RUNNING THROUGH INFECTION BUT CLEAN AT TERMINI.

In the case of lines running through an infected place, but with both their termini in clean territory, the control of the entire inspection system should be in the hands of one officer.

Here there are no relays to look after, but if the place is of any size there should be designated points on either side of the town at which trains should stop and be searched for tramps and stowaways.

The inspectors should, if possible, run from end to end. If the run is a long one they work one way and sleep on the way back. If this is impracticable they exchange at meeting points.

If the place is too small to warrant running a regular refugee train, or using refugee coaches attached to regular trains, a way of escape can be arranged by running a special on certain days.

In either method an inspector should be assigned to the duty of superintending the embarkation of refugees, giving to such as desire it a descriptive card with the date, to be used by the recipient as a means of identification, should he desire to enter infectible territory after serving out his period of detention elsewhere. In all these methods it is desirable that the refugees be handled on day trains only, for the greater facility in observation and control thus obtained.

The method of preparing lists of passengers, reporting, and making transfers being as already described.

THE CLASS OF ROADS THAT ARE ONLY COVERED ON ACCOUNT OF THE POSSIBLE LATERAL MOVEMENT OF PASSENGERS FROM OTHER LINES.

In some cases this may be very important, as in the work about Brunswick, Ga., where the Savannah, Florida and Western and the Florida Central and Peninsular, while they did not enter the city, were of quite as much importance as the roads that did.

Ordinarily, however, this is not the case, and it is not necessary for the inspectors to list their passengers. They should, however, carefully investigate the antecedents of all and allow no one to leave the train in infectible territory whose history is not clear.

At junction points, where passengers may be received from lines from infected territory, all passengers boarding the train must be required to present their papers.

If the connection is a close one the refugees are received direct from the inspector on the other train, otherwise they should have transfer cards as described below.

AS TO THE USE OF SEPARATE CARS.

As the number of such persons will usually be very small, often not over one or two, and as they are usually well when received, it will not be necessary to put them in separate cars.

Theoretically this is not sound, but practically it is. It must be remembered that much of the isolation to which we subject refugees is for the alleviating of the uneasiness of other passengers and for the restoration of public confidence in the more seriously threatened, and consequently panic-stricken, sections.

The inspectors will run straight through, or to meeting points, as is most convenient.

NO RESTRICTION TO TRAVEL FROM COLLATERAL POINTS IN CLEAN TERRITORY.

No restrictions need be put upon the movements of people boarding the train at points out of reach of the main lines from infected territory, but those received from such lines and those unable to give a satisfactory account of themselves must be prevented from leaving the train in infectible territory.

If the inspector only goes to the meeting point and has refugees on his train he delivers a list of them to the man he transfers them to.

MANAGEMENT OF JUNCTION POINTS.

The management of junction points is often very difficult. It is absolutely necessary for their control that we should reach an amicable arrangement with the local authorities, otherwise travel may be utterly and needlessly blocked and great loss and hardship be imposed on innocent people.

In two conspicuous cases last fall business was paralyzed and the really necessary work of inspection severely hampered by the unnecessary obstinacy of the authorities at important junctions.

If the train connections are such that a lay over or transfer through town is necessary, these should be in charge of a man stationed permanently at the junction.

Transfers should be made under direction and the travelers be absolutely under control of the inspector.

The inspector on the train which brings the people should give to each a signed card bearing the date, name, place of origin, destination, and train desired to be taken. The card should state across the face that it is good only on day of issuance.

By means of these cards the inspector at the junction can rapidly decide what action is necessary, and when the traveler boards the train the card, previously initialed by the man at the junction, will serve as a guide to the inspector thereon.

If the junction is a close one the cards are also to be given as a guide to the new inspector.

This may seem impracticable, but it is not, and is a help to the inspectors.

If the local authorities are competent and willing they can be allowed to handle the transfers. They did so at Memphis in 1897. Such a reciprocity is in many ways most desirable, even at the loss of a certain amount of direct control.

A volume might be written on the subject of the possible action of local authorities—how they may aid or hinder the work, and how the conditions thus arising are to be met—but as neither the prophetic vision of Daniel nor the wisdom of Solomon could foretell the occurrence of or divine the reason for much that they will do, it is useless to discuss the matter here.

Through deserving the confidence of the people by conscientious attention to details all will be done that can be done.

This, assuming the law to be as at present or as it may be if amended. The wishes of the people will have to be deferred to as long as not inconsistent with safety.

OFFICER IN CHARGE SHOULD KNOW ALL LOCAL AUTHORITIES.

The officer in charge should visit as many places as possible along his roads and get in personal touch with the authorities, but should avoid "conferences" at any cost. He should see that all local rules not inconsistent with his orders and the regulations are enforced as if they were his own, and should promptly advise his inspectors of any changes in the State or local rules.

It may be observed that I have often spoken of "satisfactory evidence" as to recent whereabouts.

WHAT CONSTITUTES SATISFACTORY EVIDENCE OF HEALTH.

It is the custom to speak of "health certificates" in this connection. I have purposely refrained from doing so.

The ordinary "health certificate" certifies to nothing at all. The city of New Orleans issued health certificates when the town was full of fever. At Memphis the certificate was merely a statement by the health board that A. B. had appeared and made certain statements which they had not verified. Atlanta had the best form of certificate, but none of them were good for much. The only certificate that is worth much is one in which the physician or other responsible party makes oath before an officer possessing a seal that the facts are so and so, or in which such an officer verifies the signature of the party issuing it. This is a hardship on the ignorant and an expense to the needy, and by no means to be always exacted. An intelligent inspector can soon learn to divide the sheep from the goats. The sales books of drummers, telegrams, the postmarks of letters, the dating stamps of the railroad agents at the various places at which the man has been, and many forms of evidence are all worth more than the ordinary certificate. The trafficking in "health certificates" was quite an industry last fall, and the issuing of them at 50 cents or $1 apiece proved better to some people than private practice.

Of course immunes and those who hold discharges from service camps may be allowed to go freely to their destinations. For most of the others the sworn health certificates or similar evidence must be required; for wayside stations the identification of the station agent suffices.

Probably no one will again be called upon to handle such thousands of people as the Nashville Exposition put in motion throughout the South, so I have said nothing of the special organization in such cases.

At best the scope of this article does not admit of much discussion of details. They must be left for their management to individual judgment.

WHAT IS TO BE DONE WITH PERSONS WHOSE HISTORY IS IN DOUBT.

One part is of interest, however. What is to be done with persons without satisfactory evidence as to their antecedents who are found upon trains bound for infectible territory? We can't land them. What, then, can we do with them? We can compel the roads to return them to the points whence they took them, but if they have not the wherewithal to feed themselves en route, and if they come to the line on which we find them from some other line, their condition may be most distressing.

I am of the opinion that, if such people are manifestly innocent of intent to evade the inspectors, we should feed them en route, if necessary, and use our utmost endeavors to have them returned to their homes.

For the far larger class of unfortunates, who, while of perfectly acceptable status as far as the national inspector is concerned, are rejected by local authorities, there is very little to be done.

They are in the position of an old man on the Illinois Central, whom the road, in trying to deliver at a point in southern Mississippi, had three times in succession transported from Chicago to the South and back. As he began his fourth return trip he lifted up his voice and wept, "The good Lord only knows what will become of me."

FREIGHT TRAFFIC.

The handling of freight trains presents special difficulties. I am of the opinion that freight trains are a greater menace than passenger trains. They are more numerous, they run at irregular hours, they make longer and more frequent stops, and they are made up of cars from all sorts of localities. So much for the trains themselves.

PERSONNEL OF FREIGHT TRAINS PARTICULARLY DANGEROUS.

As to their personnel, the crews are less subject to control than passenger crews; they are changed more frequently, and the handling of the train at the stops involves more opportunities for contact with the people at those places; then we have to remember that the freight train is the "route of election" chosen by tramps proper and other irregular travelers; of these latter the most dangerous class are the railroad men out of a job, who are smuggled along by their mates in cabooses or box cars, as the discipline maintained on the road may determine.

TRAMPS AND RAILROADERS SEEKING WORK.

They come from infected places perhaps because work is slack and they go anywhere they choose, inspection or no inspection. The crew will usually promptly eject the tramp, but will harbor the "railroader."

All freight crews must be changed at relay stations, as the passenger crews are, and when there is much business out of a large and thoroughly infected place there should be inspectors at the next division points to inspect the crews arriving at the relay stations and to look out for irregulars.

WHAT TO DO WITH IRREGULAR TRAVELERS.

This brings up the question of what shall we do with the tramps and irregulars found on either freight or passenger trains. Usually the crew promptly ejects them—almost invariably in the case of passenger crews—without the slightest care as to where they come from or how dangerous they may be to the community where "fired."

OBSERVATION CAMPS.

To meet this difficulty Acting Assistant Surgeon Frick has suggested that at certain designated points there should be small camps of observation, and that the train crews should have positive orders *not* to eject persons found stealing rides, but to deliver them at said points to the care of an inspector. They can then either be forwarded in batches to noninfectible territory or made to serve out their period of detention.

Even where there is a regular detention camp within a few hours' run, it would be much better to deliver the tramps at the certain points as suggested by Dr. Frick, and then transfer them under guard to the regular camps.

This duty could be assigned to the men on duty at the freight division termini.

The scope of this article does not admit of treating these questions in fuller detail. It is a knotty problem, and will tax the ingenuity of anyone who has to handle it.

UNIFORMITY OF METHOD ESSENTIAL.

In conclusion, too much stress can not be laid upon the necessity of securing uniformity of method by putting as much territory as possible under one officer and of supplying as many regular officers as possible as assistants.

Under existing laws we can not do so very much toward suppressing the disease when it occurs, but we can do something toward limiting its spread.

SYNOPSIS OF THE INTERSTATE QUARANTINE REGULATIONS OF THE TREASURY DEPARTMENT.*

By P. A. Surg. J. H. WHITE.

In undertaking to prepare a précis of the Interstate Quarantine Regulations, it is apparent at once that such précis will be only a synopsis of the articles preceding this; i. e., Sections D, E, and F.

NOTIFICATION.

It is imperatively necessary that early notification should be given to the Surgeon-General of the United States Marine-Hospital Service of the existence of the first case of yellow fever in any community if good results are to be attained. It does not follow that this information becomes public property. What is easy if promptly handled becomes a herculean task if allowed to go unheeded for several weeks. Local physicians should notify their local or State health officers and the latter should in turn notify the Surgeon-General of the Marine-Hospital Service, either directly or through the nearest Marine Hospital officer. Telegrams conveying said information can be sent collect.

RELATION OF MUNICIPAL TO INTERSTATE EPIDEMIC WORK.

It should be borne in mind that the best possible means for prevention of interstate spread of any disease is the suppression of the initial case *at once.* The fundamental principle of sanitary work is, ***End the disease with the first case.*** It may be stated as a fact that the risk of spread and the work of suppression increase in geometric progression as the number of infections increase.

ISOLATION OF SICK.

Upon the discovery of a case of yellow fever, the patient should be promptly isolated and care taken to disinfect all textiles, etc., which may have been infected by the sick. Careful examination should be made of each and every inmate and all healthy persons placed in another house, there to undergo eight days' observation at the hands of a competent physician, and if no case occurs among them they should be released.

Before isolation, however, their clothing should be disinfected. The infected house should be rigorously quarantined and no one allowed entry or exit except the physician, who should isolate himself, unless immune, and adopt all proper precautions, arrangements being made for the provisioning of the nurses and the patients in such manner as to avoid any spread of infection.

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* The interstate quarantine regulations promulgated by the Secretary of the Treasury are published in full and issued in pamphlet form by the Marine-Hospital Bureau.

All this is fully stated by Surgeon H. R. Carter in Chapter I, Section D, including the disinfection.

DEPOPULATION.

Two distinct means offer themselves in the handling of the first cases:

I. Removal of the sick and those exposed with them to isolated and separate, and as nearly as may be noninfectible quarters.

II. Depopulation of the immediate vicinity within a radius of about 200 yards, and then treating the patient where he sickened, with a subsequent disinfection of not only his own but other nearby residences, and especially those to leeward of the sick.

A little thought will show that the first is by far the best method of dealing with original cases, as it necessitates less disinfection and tends to remove public disquietude, which in itself is a factor not to be despised.

When it is found that we have several cases in a town and the source is not definitely known, it is, I believe, advisable to quarantine with an impassable cordon the whole town, but only until inspection, house to house, shows exactly what section of the town is infected; then release the remainder and cordon that section until it can be depopulated into a camp; treat the sick until well, and disinfect all houses where sickness has existed. I am of the opinion this is possible if the presence of yellow fever is discovered before there are more than twenty cases existent; and while it would be difficult of execution, yet it promises such results as to justify the effort; and if successful, it means the extirpation of an epidemic more promptly than would be otherwise possible.

Success in this way was attained at Franklin, La., Nittayuma and Cayuga, Miss., and other points. (See Section D, Chapter I, by Surg. H. R. Carter.)

HOUSE-TO-HOUSE AND NEIGHBORING VILLAGE INSPECTIONS.

Immediately on the discovery of yellow fever inquiry should be made as to the whereabouts of persons who have been exposed. These should be traced to neighboring or even to distant villages or places and kept under observation. In the meantime a careful house-to-house inspection should be made in the infected locality.

PASSENGERS LEAVING INFECTED PLACES.

Exit should be permitted to all persons from infected towns who desire to go to places beyond the limit of possible epidemic, i. e., such as from New Orleans to Chicago, and in such cases disinfection of effects, while of course salutary, so far as persons themselves are concerned, is not necessary if they remain North.

All parties, save immunes, going to places inside such lines, i. e., into infectible territory, should go into the detention camps mentioned in this writing.

PROVED IMMUNES GOING THROUGH AFTER BAGGAGE DISINFECTION.

All persons, wherever going, should be under the eye of train inspectors, and this should particularly include railroad employees and officials, as by constantly entering the infected locality they are peculiarly liable to be carriers of infection.

All trainmen should be relayed at some convenient point near the infected city, so that no single one of them shall go beyond that relay point, either of the crew belonging at the infected or that belonging at the noninfected end of the line.

Coaches should be disinfected at their point of destination (in clean territory), and, in so far as convenient, upholstered coaches should not be used (this simply to minimize the work of cleansing).

Train inspectors should also be relayed and an inspector accompany each train until it reaches noninfectible territory. They should also keep watch on return trip against the doubling back of people recently out of infected zone and seeking entry to clean but infectible territory.

Exit should be encouraged early in the outbreak, because at that time the amount of possible risk is less than it will be when the town is largely infected.

GUARDS, ATTENDANTS, ETC.

It is of prime importance that all persons exposed to the sick man or his belongings, in the endeavor to suppress infection, should be immune to yellow fever, and wherever possible all should be so. In the case of the death of a patient the body shall be disposed of under such sanitary precautions as will prevent the conveyance of infection.

WHEN NECESSARY TO PUT ON ABSOLUTE QUARANTINE.

When the number of cases becomes so great that it is not possible to exactly trace the origin of each, and it becomes evident that cases are being concealed, a complete quarantine of the whole community becomes necessary.

I shall not enter fully into this subject, as it is entirely covered in Section D by several writers, and notably by Dr. Carter.

If I have succeeded in impressing upon the reader the imperative necessity of detection and isolation, and proper handling of first cases, I am more than satisfied. This is the very keystone of interstate quarantine measures.

We must treat first cases with such tender consideration—provide such nursing and medical attendance, and at little or no cost to the patient's family—that isolation shall become even attractive, if that be possible, for be it well remembered that concealed cases will spoil the best arrangements.

A PRÉCIS OF THE UNITED STATES QUARANTINE REGULATIONS FOR DOMESTIC PORTS WITH REFERENCE TO PREVENTING THE INTRODUCTION OF YELLOW FEVER INTO THE UNITED STATES.

By Surg. PRESTON H. BAILHACHE.

As yellow fever is not an endemic disease of this country, regulations for the prevention of its introduction from abroad have been prepared by the Surgeon-General of the Marine-Hospital Service, under the direction of the Secretary of the Treasury, and promulgated by the Department under date of April 26, 1894.

PRIMARY MEASURES.

The primary measure to be adopted to prevent the introduction of this disease into the United States is the establishment at the principal ports of the country of completely equipped quarantine stations for the inspection and treatment of vessels, their passengers, crews, and cargoes. At smaller stations, where it is impracticable to fully equip and maintain a complete establishment, provision should be made for the inspection of such vessels, and these inspections should be maintained at every port throughout the year.

PERSONNEL SHOULD BE IMMUNE.

The personnel of Southern quarantine stations should be immune to yellow fever, and all articles liable to convey infection should be handled only by the employees of said station, if practicable.

INSPECTION.

Vessels arriving at ports of the United States under the following conditions shall be inspected by a quarantine officer prior to entry:

A. Any vessel with sickness on board.

B. All vessels from foreign ports.

C. Vessels from domestic ports where yellow fever prevails.

D. Vessels from foreign ports carrying passengers having entered a port of the United States without complete discharge of passengers and cargo. Such vessels shall be subject to a second inspection before entering any other port. Vessels from ports suspected of infection with yellow fever, having entered a port north of the southern boundary of Maryland without disinfection, shall be subjected to a second inspection before entering any port south of said latitude during the quarantine season of such port.

The inspections of vessels shall be made by daylight, except in case of vessels in distress.

In making the inspection of a vessel, the bill of health and clinical record of all cases treated during the voyage, crew and passengers' lists and manifests, and, when necessary, the ship's log shall be examined. The crew and passengers shall be mustered and examined and compared with the lists and manifests and any discrepancies investigated.

No person except the quarantine officer, his employees, United States customs officers, or agents of the vessel, shall be permitted to board any vessel subject to quarantine inspection, until after the vessel has been inspected by the quarantine officer and given its discharge.

VESSELS SUBJECT TO QUARANTINE MEASURES.

A. Vessels arriving with yellow fever on board.

B. Having had such on board during the voyage or within thirty days next preceding arrival, or, if arriving in the quarantine season, having had yellow fever on board after March 1 of the current year, unless satisfactorily disinfected thereafter.

C. Vessels from noninfected ports, but bringing persons or cargo from places infected with yellow fever.

D. From ports where yellow fever prevails, unless disinfected in accordance with these regulations, and not less than five days have elapsed since such disinfection.

Exceptions to C and D.—Vessels arriving during certain seasons of the year, to wit, from November 1 to April 1, may be admitted to entry.

Vessels bound for ports in the United States *north of the southern boundary of Maryland*, with good sanitary condition and history, having had no sickness on board at ports of departure, en route, or on arrival, provided they have been five days from last infected or suspected port, may be allowed entry at port of destination. But if said vessels carry passengers destined for places south of this latitude the baggage of said passengers shall be disinfected.

In making an inspection of a vessel, if from a port where yellow fever prevails, and between April 1 and November 1 of any year, the inspector shall ascertain the destination of each passenger thereon, and if bound for places south of the southern boundary of Maryland, the baggage of such passenger shall be disinfected according to the rules for such articles infected with yellow fever. Such baggage shall be labeled.

Vessels engaged in the fruit trade from ports declared safe for this purpose by the Supervising Surgeon-General Marine-Hospital Service, may be admitted to entry without detention, provided that they carry no passengers and have carried no passengers from one port to another, and have no household effects or personal baggage in cargo, and have complied with the special rules and regulations made by the Secretary of the Treasury with regard to vessels engaged in said trade.

PASSENGER TRAFFIC.

Passenger traffic may be allowed during the quarantine season from any port infected with yellow fever to any port of the United States south of the southern boundary of Maryland under the following conditions:

(*a*) Vessels to be of iron, and clean immediately prior to taking on passengers.

(*b*) The vessel must lie at moorings in the open harbor and not approach the wharves, nor must the crew be allowed ashore at the port of departure.

(*c*) All passengers and crew must be immune to yellow fever, and so certified by the United States medical officer.*

(*d*) All baggage which has not been disinfected at the port of departure by the United States medical officer, or which is not in bond for points north of the southern boundary of Maryland, shall be disinfected at the quarantine at the port of arrival; no bedding or household effects to be allowed to enter.

GENERAL REQUIREMENTS AT QUARANTINES.

Pilots bringing infected vessels will be detained in quarantine a sufficient time to cover the period of incubation of the disease for which the vessel is quarantined if, in the opinion of the quarantine officer, such pilots have been exposed to infection. The dunnage of pilots shall be disinfected when necessary.

No direct communication shall be allowed between quarantine, or any vessel in quarantine, with any person or place outside, and no indirect communication except under the supervision of the quarantine officer.

No ballast shall be allowed to leave the quarantine station unless disinfected.

Where it is impossible to disinfect cargo in situ, it shall be removed and disinfected in the manner provided for articles of their class in these regulations; such articles to be unpacked and so arranged as to allow the disinfectant used to reach every part of all surfaces of said articles.

Vessels arriving at any port of the United States, having yellow fever aboard during the quarantine season, shall be remanded to an anchorage set apart for infected vessels, and there to remain until after the discharge of the passengers and purification of the vessel.

All passenger baggage disinfected under the requirements of these regulations shall be labeled.

Vessels detained at any national quarantine will be subject to such additional rules and regulations as may be promulgated from time to time by the Supervising Surgeon-General.

The following is the form of certificate which shall be issued to the vessel by the health officer when she is released from quarantine:

——, —— ——, *189—*.

I certify that ——, of ——, from ——, has in all respects complied with the quarantine regulations prescribed by the Secretary of the Treasury, and that in my

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*The evidence of immunity which may be accepted by the sanitary inspector is:

First. Proof of continued residence in an endemic focus of yellow fever for ten years.

Second. Proof of previous attack of yellow fever.

opinion she will not convey quarantinable disease. Said vessel is this day granted free pratique.

——— ———,
Health (Quarantine) Officer,
Port of ———.

SPECIAL REGULATIONS RELATING TO NAVAL VESSELS.

1. At domestic ports such communication may be allowed with vessels of the United States Navy as the certificate of the medical officer of said vessel shows will not be liable to convey infection.

2. The certificates of the medical officers of the United States Navy that the United States quarantine regulations have been complied with may be accepted for naval vessels.

3. Vessels of the United States Navy, having entered the harbors of ports infected with yellow fever, and having held no communication which is liable to convey infection to the vessel or her crew, may be exempted from the quarantine restrictions imposed on merchant vessels from such ports.

TREATMENT OF VESSELS INFECTED OR SUSPECTED OF BEING INFECTED WITH YELLOW FEVER.

Where practicable, at once remove the sick to hospital; remove and isolate all persons not required for the care of the vessel.

If the hold is deemed infected, there shall be a preliminary disinfection as hereinafter provided.

The bilge should be cleansed with sea water, if possible, before disinfection, and the hold rendered mechanically clean.

All ballast except close grained hard rock must be discharged. This may be retained aboard if disinfected by immersion in an acid solution of bichloride of mercury, 1 to 800.

After discharge or disinfection of ballast the vessel should be disinfected.

If it is so stowed as to admit of disinfection, the cargo and the hold may be disinfected without breaking bulk, except to such a degree as to render disinfection practicable.

The personnel of the vessel shall be detained five days from completion of the disinfection, or three days if all baggage, etc., is handled exclusively by quarantine employees.

If the vessel has been disinfected under the supervision of an accredited medical officer of the United States at the port of departure, the period of quarantine may date from completion of such dininfection, and shall not be less than five days.

The following regulations are provided for the disinfection of a vessel infected or suspected of being infected with yellow fever:

DISINFECTION BY SULPHUR DIOXIDE.

Holds to be treated with sulphur dioxide, 10 per cent strength per volume, forty-eight hours' exposure for iron vessels, and seventy-two hours' for wooden vessels.

Empty holds to be disinfected as follows:

(*a*) If of iron, by sulphur dioxide gas, 10 per cent strength per volume, for twelve hours' exposure, followed by washing with an acid solution of bichloride of mercury, 1 to 800, applied under pressure to all surfaces by means of a hose.

(*b*) If of wood, by the same methods as the preceding, save that the exposure to sulphur dioxid gas shall be for forty-eight hours; air streaks to be open.

Cabin, forecastle, etc., after mechanical cleaning, to be first treated with sulphur dioxid, not less than 6 per cent strength per volume, twenty-four hours' exposure. Then, after cleansing with water if desired, wash all exposed surfaces with a solution of bichlorid of mercury, 1 to 800, or pure carbolic acid, 3 per cent.

DISINFECTION BY STEAM.

Clothing, bedding, and all fabrics which can be removed, not injured by steam, shall be disinfected:

(*a*) By exposure to steam at a temperature of 100° to 102° C. for thirty minutes after such temperature has been reached.

(*b*) By boiling for fifteen minutes; all articles to be submerged.

(*c*) By a thorough saturation in a solution of bichlorid of mercury, 1 to 1,000, and allowed to dry before washing.

Articles injured by steam (rubber, leather, etc.), and containers, to the disinfection of which steam is inapplicable, shall be disinfected by (*a*) thoroughly wetting all surfaces with a solution of bichlorid of mercury, 1 to 800, or a 5 per cent solution of pure carbolic acid, and allowed to dry in open air; or (*b*) by exposure to the sulphur fumigation in cabin, forecastle, or hold.

DISINFECTION BY FORMALDEHYD GAS.

Since the introduction of formaldehyd gas as a disinfector, additional regulations were promulgated August 5, 1897, as follows:

DISINFECTION OF STEERAGE, FORECASTLE, AND CABIN OF VESSELS.

After the removal of the bedding, carpets, and furnishings, all apertures being tightly closed, the steerage, forecastle, and cabin of a vessel may be disinfected by formaldehyd gas in a percentage of not less than 2 per cent per volume strength, the time of exposure to be not less than twelve hours. The gas may be generated by one of the following methods:

(*a*) From methyl (wood) alcohol by means of special lamps, using not less than 600 grams (750 cubic centimeters = 1⅗ pints) of methyl alcohol for each 25.5 cubic meters (1,000 cubic feet) of space, the time of exposure to be not less than twelve hours.

Lamps used for generating formaldehyd gas from methyl alcohol should change not less than 1 liter (1.01 quarts) of the alcohol within an hour.

(*b*) From an aqueous solution, containing 40 per cent of the gas, known under the names of formalin, formol, or formalose. The gas is best evolved from these solutions by the addition of from 10 to 30 per cent of a neutral salt, preferably calcium chloride or sodium nitrate, and heating the mixture in a special boiler. One liter of a 40 per cent solution of formaldehyd gas will evolve about 1,425 liters (50.1 cubic feet) of the gas at 20° C. (68° F.), and will be sufficient for 71 cubic meters (2,505.5 cubic feet) of space.

(*c*) From the substance known as trioxymethylene, by means of a special lamp, not less than 2 grams (30 grains) to be used for each cubic meter (35.29 cubic feet) of space.

After the disinfection of apartments (steerage, cabin, and forecastle) by formaldehyd gas, the latter should be neutralized by ammonia gas evolved from water of ammonia by heat or by evaporation from water of ammonia sprinkled upon the floor.

NOTE.—The quantity of water of ammonia required for neutralization after each of the above-named methods is as follows: After method (*a*), 1 liter (1.01 quarts) of water of ammonia for each 1,000 cubic centimeters (1.01 quarts) of wood alcohol used; after method (*b*), 1¼ liters (1.26 quarts) of water of ammonia for each liter (1.01 quarts) of formalin; after method (*c*), 1 liter of water of ammonia for each 150 grams (5 ounces) of trioxymethylene.

DISINFECTION OF CLOTHING, BEDDING, UPHOLSTERED FURNITURE, ARTICLES OF LEATHER, ETC.

These may be disinfected by formaldehyd gas in the ordinary steam disinfecting chamber, the latter to be provided with a vacuum apparatus and special apparatus for generating and applying the gas. The gas should be applied in a dry state in not less than 20 per cent per volume strength, the time of exposure to be not less than one hour. Clothing bedding, etc., thus disinfected should be exposed in situ to an equal amount of ammonia gas generated by the special apparatus attached to the chamber, using 1 liter of water of ammonia to each liter of formalin; or compressed ammonia gas may be used.

NOTE.—The special apparatus must consist of a generator, constructed of copper, for evolving formaldehyd gas from its solutions, and a similar one of iron for evolving ammonia gas for neutralization. The principle upon which this apparatus is constructed is described and illustrated in Public Health Reports, Marine-Hospital Service, January 29, 1897, Vol. XII, No. 5.

A CONCISE EXPLANATION OF THE MARITIME QUARANTINE REGULATIONS OF THE TREASURY DEPARTMENT RELATING TO YELLOW FEVER.

By P. A. Surg. J. H. WHITE.

INTRODUCTORY.

It is the purpose of this article to convey to masters of vessels and other interested parties a clear idea of the demands put upon them by the United States Quarantine Regulations.

REQUIREMENTS AT FOREIGN PORTS INFECTED OR SUSPECTED OF BEING INFECTED WITH YELLOW FEVER.

VESSELS AND CARGO.

All vessels intending to enter ports of the United States south of Chesapeake entrance should, while lying in yellow-fever ports or ports under suspicion of yellow fever, avoid the wharves and lie at anchor in the open stream or harbor. They should take on board from said ports only such stuff as may be absolutely essential, and all that is taken aboard should be disinfected. *This is especially true of clothing.* Household goods should be debarred.

DISINFECTION.

If it be necessary to receive clothing (as of troops returning from war, etc.), and no other means is at hand, a compartment of the ship may be set aside temporarily for the purpose and the clothing disinfected therein by hanging on cords so as to freely expose all surfaces, and then exposing to sulphur dioxid for twenty-four hours, burning 5 pounds of sulphur to each 1,000 cubic feet of space so devoted. The vessel's own steam may be utilized for disinfection in any tight compartment above water line. This will ordinarily accomplish the result desired, or will at least minimize the danger of an outbreak among the crew and passengers.

It is safest to disinfect *all clothing*, though as a matter of fact there is little danger in that actually worn, unless the wearer has been for a long period in direct touch with yellow fever, as in case of doctors and nurses.

PERSONS TAKEN SICK ABOARD SHIP EN ROUTE TO THE UNITED STATES.

Any person taken sick aboard ship bound for the United States from yellow-fever countries should be promptly isolated.

A room, well aft in a steamship or forward in a sailing vessel (in order to be to leeward of all healthy persons), should be set apart and kept constantly ready for yellow-fever suspects.

The patient and his exposed clothing and bedding should be at once taken to this room.

In this connection I would refer to the articles on Diagnosis of Yellow Fever, by Drs. Murray and Guiteras, and to Section D, Chapter I, by Dr. Carter, on measures to prevent the spread of fever.

These articles distinctly show the possibility of early diagnosis in the first place and of perfect isolation and noninfection of surroundings in the next.

LIMITATION OF INFECTION ON SHIPBOARD.

The latter point, i. e., not to allow infection of the hospital room itself, is of manifest importance, and if careful disinfection of all clothing and bedding is done as fast as disused, and if these articles are changed every twenty-four to forty-eight hours and rubber sheet used over mattress, the end is likely to be attained. This protection of the ship, and confinement of infection to one narrowly limited portion thereof, has been done. I have seen it, and I think Surg. H. R. Carter reports having seen this limitation successfully carried out by ship captains.

With a skillful surgeon on board it should be possible to stamp out an infection.

TREATMENT UPON ARRIVAL AT PORTS OF THE UNITED STATES.

Pilots.—Vessels from ports suspected of or infected with yellow fever should not be boarded by pilots when bound to ports south of Chesapeake entrance, but should be "conned in" by the pilot to the nearest inspection station.

WHEN A VESSEL IS SUBJECT TO QUARANTINE.

All such vessels are subject to disinfection and detention between April 1 and November 1 of each year, unless they be vessels of the United States Navy, provided with medical officers of said service, and said medical officers can certify that there has been no communication with the shore at infected points, or only such carefully guarded communication as is free from danger. (See previous chapter, Special Regulations for Naval Vessels.)

TREATMENT OF INFECTED OR SUSPECTED VESSELS.

Bear in mind that a suspected vessel is to all intents an infected vessel in so far as treatment is concerned and differs therefrom only in that it probably has no sickness aboard.

The treatment for such vessels is laid down in full in the précis, Section H, Chapter I, by Surg. P. H. Bailhache, and I will here only state that subsequent to the completion of the necessary disinfection, a detention of from three to five full days of twenty-four hours each is necessary to the end that we may be reasonably sure that no accidental exposure during the process of disinfection results in an outbreak of yellow fever after discharge of the vessel. Five days' detention is required unless disinfection of all baggage, dunnage, etc., has been performed exclusively by quarantine employes.

The details of disinfection are so fully elaborated in Dr. Bailhache's article as to render repetition unnecessary.

Should any person aboard be attacked by yellow fever while the vessel is under observation subsequent to her disinfection, it becomes necessary to at once remove the sick person and subject his vacated premises to a rigorous redisinfection; but, unless there has obviously been a fault somewhere in the previous work, it is not necessary to redisinfect the whole ship nor to detain her another full five days. This is generally done, but it is really more a measure to satisfy public anxiety than a precaution dictated by true hygienic principles. The fact being well established that *a yellow-fever patient does not infect his surroundings under forty-eight hours at least*, *or*, *in better language*, *that infection resulting from a patient does not become active under forty-eight hours*, we should take advantage of this to avoid a spread of the disease and full infection of the ship, and it is plain that removal of patient and disinfection of his quarters does this effectually. Here let me say, however, that it is well to have grave suspicion that the primary disinfection was not thorough if a case develops after six days have passed subsequent to it, and such late development should justify a full secondary disinfection of the whole ship.

QUARANTINE DETENTION AT NORTHERN AND SOUTHERN PORTS.

The different rules adopted for Northern and Southern ports, with regard to vessels and persons from yellow-fever infected ports are concisely set forth in the following extract from a letter addressed by the Surgeon-General of the Marine-Hospital Service to a quarantine officer in the South:

> Your third inquiry is as follows: "Whether the rule requiring the detention of vessels three days after being disinfected is a general law, or only applying to southern ports?" In reply to this inquiry I have only to suggest a careful examination of the United States Quarantine Regulations, from which it will be seen that at all ports south of the southern boundary of Maryland, which is an arbitrary line, vessels coming from an infected port, whether the vessel itself gives evidence of yellow fever or not, are subject to disinfection and detention of their personnel. At ports north of the southern boundary of Maryland this regulation does not apply. If the vessel carries no known infection at a northern port it may be admitted without detention, even though it comes from a port which is ordinarily infected with yellow fever, but the passengers on such a vessel must be detained a sufficient length of time to make five days from the infected port. This is done at New York

and at our national quarantine stations on the Delaware Bay and River. The Attorney-General has rendered a decision declaring that this regulation is legal.

In regard to the change of crew at the quarantine station, you will observe that the quarantine regulations say that the personnel of the vessel shall be detained for three days after disinfection—not the vessel itself. So that if the vessel's crew is taken off immediately on entering quarantine, if the vessel is disinfected by a station's crew, there would be no objection to the vessel's being brought immediately to the port by another fresh crew which has not been subjected to contact with the vessel or any of its regular crew or engaged in disinfection. In other words, as soon as a vessel has been thoroughly disinfected it is safe, but its regular crew may develop yellow fever even three or four days after completion of disinfection; in fact, they are more likely to, inasmuch as the dunnage of the crew has been opened in the process of disinfection

I hope I have made these matters plain, and, if not, I would be pleased to answer any other questions you may ask regarding them.

The special regulations relating to passenger traffic, fruit vessels, and vessels of the United States Navy have been mentioned in the preceding article.

POST-EPIDEMIC DISINFECTION.

CIRCULAR LETTER RELATING TO RECORDS.

TREASURY DEPARTMENT,
OFFICE OF THE SUPERVISING SURGEON-GENERAL
MARINE-HOSPITAL SERVICE,
Washington, D. C., October 11, 1897.

To the Medical Officers of the Marine-Hospital Service, Acting Assistant Surgeons, and State and Municipal Health Officers:

Anticipating the work of post epidemic disinfection, which will be necessary to prevent the recurrence of yellow fever next season, your attention is called to the importance of keeping a record of each person contracting yellow fever, and the street number of each house where the fever occurs.

WALTER WYMAN,
Supervising Surgeon-General, Marine-Hospital Service.

CIRCULAR LETTER RELATING TO POST EPIDEMIC DISINFECTION AND AERATION.

TREASURY DEPARTMENT,
OFFICE OF THE SUPERVISING SURGEON-GENERAL
MARINE-HOSPITAL SERVICE,
Washington, D. C., December 1, 1897.

To Commissioned Officers of the Marine-Hospital Service, Acting Assistant Surgeons, and State and Municipal Health Officers:

Referring to circular letter issued by this Bureau October 11, 1897, in which attention was called to the importance of keeping a record of the name of each person contracting yellow fever, and the street and number of each house where yellow fever occurred, I have to state that inasmuch as the fever has disappeared in the South, it is now deemed necessary to begin the work of post epidemic disinfection. In order that the same may be uniform and thorough in its character the following plan is recommended:

HOUSE-TO-HOUSE INSPECTION.

(*a*) The medical officer in command shall make, or cause to be made, house-to house inspection of all infected localities, and obtain complete lists (giving number and street when practicable) of all buildings, whether private dwellings, public houses, or hospitals, in which yellow fever occurred or where suspicious disease existed during the past summer and fall—the city or town to be divided into districts.

(*b*) This inspection should be made by competent sanitary officers, under direction of the medical officer in command, and every part of the premises must be carefully inspected, including the rooms, basements, cellars, passages, closets, and garrets, the sinks, drains, cesspools, latrines, privies or water-closets, the stables, sheds, outhouses, pens, etc.

(*c*) The inspection is not only for the purposes of disinfection, but also is intended to place each house and its surroundings in a perfectly sanitary condition, and includes the inspection of all streets, alleys, and byways.

(*d*) The inspection should include an examination into the water supply, and particularly as to the proximity of wells, cisterns, and springs to the privies, stables, pens, and other suspicious surroundings.

LIST OF YELLOW FEVER SUFFERERS AND SUSPECTS.

Make a complete list of all persons exposed to, or who may have contracted the disease, with the result in each case.

(*a*) If death resulted, where buried and under what precautions.

(*b*) If recovered or removed to another domicile in the same city, town, or place (or if departed from the neighborhood), ascertain all facts and make note of the same in order that it may be determined what action shall be taken in each case.

GENERAL DISINFECTION.

(*a*) It is recommended that after the inspection above provided for has been made the medical officer shall designate a competent sanitary officer to perform the thorough disinfection and cleansing of all houses and premises which he may have decided require the same, said disinfection to begin as soon as practicable after the inspection referred to has been made in any locality.

(*b*) It is recommended that the removal of all refuse, garbage, and other deleterious matter be included in the work of disinfection, and that all articles of little value, such as old rags and other accumulations of worthless material, be destroyed, whether found in dwellings or "slop-shops."

(*c*) It is recommended that the inspectors inform all parties whose houses are visited that no injury to their houses or contents will result from the disinfection contemplated, that even the most delicate fabrics can now be rendered free from contagion by a harmless process of disinfection, and that it is absolutely necessary for the protection of themselves and the community in which they live.

DISINFECTION OF HOUSES.

(*a*) The use of formaldehyd generators or lamps is recommended for the disinfection of houses and their contents. The details of their management for generating and applying formaldehyd gas should be fully understood by the sanitary officers in charge of the work.

(*b*) All the contents of the houses, including wearing apparel of every description, should be spread about the rooms; bedding or mattresses not used by the sick should be placed upon the chairs or tables, or, better still, hung up in the yards and beaten; soiled bedding and mattresses used by the sick should be steamed or destroyed; trunks, closets, and bureau drawers, and all closed receptacles should be opened and their contents exposed.

AERATION.

Both before and after disinfection the houses should be opened and thoroughly aired—"chilled," if the weather is favorable—and later on all the rooms, closets, etc., should be exposed to several hours of airing during freezing weather, and repeated at intervals during the winter.

DISINFECTION OF STABLES, PENS, ETC.

The use of bichloride of mercury solution, 1:500, or carbolic acid solution, 50 parts to 1,000 parts (applied by means of a spray), is deemed sufficient if all exposed surfaces are completely saturated. Privies may be disinfected by chloride of lime or strong solution of carbolic acid.

WALTER WYMAN,
Supervising Surgeon-General.

PRESENT STATUS OF THE BACTERIOLOGY OF YELLOW FEVER.

By P. A. Surg. E. K. SPRAGUE.

Unsatisfactory as bacteriological research thus far has proved in yellow fever, so much labor has been expended in that direction that it can not be passed over in silence. In no other disease have false hopes as to the discovery of the microbic cause been so frequently raised.

In 1885 Dr. Domingos Freire* announced the discovery of an organism in the blood of yellow fever patients to which he gave the name *cryptococcus xanthogenicus.* Considerable interest attached itself to this coccus from the fact that it was claimed, and many at the time believed, that inoculations with attenuated cultures would confer immunity to yellow fever. Several thousand submitted themselves to this treatment during 1884, 1885, and 1886, and while I have been able to find only one death, reported by Baron de Ibituruna,† resulting directly from the inoculation, there is not the slightest evidence that immunity to yellow fever followed from its use. When we consider the statement of Sternberg‡ that Freire worked with mixed cultures of undetermined organisms, it is very remarkable that his inoculations were as harmless as they proved themselves. A flask, supposed to be a pure culture of the cryptococcus, was found not to contain that organism, and an examination of some of the vaccination material gave the same negative result, but in both there were several other distinct microbic species. A culture which Freire brought from Paris proved to be a coccus differing in no essential from *staphylococcus pyogenes aureus.*

Dr. Lacerda, also of Rio de Janeiro, had previously found microorganisms in the liver and kidneys of yellow fever cadavers, and he sent some of the material to Babes§ for examination. This distinguished observer found bacilli in the given specimens, but in tissues from all other well diagnosticated cases he failed to find Lacerda's bacillus, and he gave no support to the claim that it was the cause of yellow fever.

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* Freire, Doctrine microbienne de la fièvre jaune, Rio de Janeiro, 1885.

† Baron de Ibituruna, Annual Report United States Marine-Hospital Service, 1889, p. 187.

‡ Sternberg, Annual Report United States Marine-Hospital Service, 1889, p. 147.

§ Babes, Les Bacteries, Paris, 1890, Vol. II, p. 154.

In 1885 the announcement of Dr. Manuel Carmona* y Valle of the discovery of the *peronospora lutea* and of its etiological relationship with yellow fever was presented for the consideration of the scientific world. He maintained that the spores of this organism gave birth to a *mucédineé*, which, entering the human economy, in turn gave rise to the disease, and later was transformed into the *peronospora lutea.* He practiced preventive inoculations, using the residue, after evaporation, of urine in which the organism was found. The results were what would be expected from such an unscientific procedure as the inoculation of the dried salts and organisms from decomposing urine.

In 1887, Gibier,† at Havana, isolated from the contents of stomach and intestines a liquefying bacillus, which, although not constantly present in yellow-fever cadavers, was nevertheless heralded by its discoverer as the direct cause of the malady. As an evidence of the causative relation of this microbe to the disease, he stated that there appeared a black sediment in liquid cultures after twenty-four hours. This pigment, he said, gave the characteristic appearance to the contents of the stomach and intestines. None of the subsequent disinterested observers were able to confirm this remarkable peculiarity of the bacillus. It was pathogenic for mice and guinea pigs, but the post-mortem lesions bore little, if any, resemblance to those of yellow fever.

That same year Dr. Carlos Finlay‡ obtained from the blood and blister serum of yellow-fever patients an organism to which he gave the name *micrococcus tetragenus febris flavæ*, and which he claimed stood in an etiological relation to the disease in question. A few months later Kinyoun§ found this coccus on the skin of those sick with malarial fever, hailing all the way from Portland, Me., to Vera Cruz, Mexico. A little later Finlay abandoned his earlier claims.

In a summary of an investigation which included all the previously mentioned organisms, Sternberg‖ says:

> Among the microörganisms encountered there is not one which by its constant presence and special pathogenic power can be shown indisputably to be the specific infectious agent in the disease.

About a year ago Havelburg,¶ by a method similar to that employed by Gibier, viz, by inoculating guinea pigs with the contents of the stomach or intestines, succeeded in isolating a bacillus for which the usual claims were made. In his description of the organism, although he goes to some length into the differentiation, it is difficult to see why it should not be classed in the colon group, and indeed most bacteriologists who have studied this bacillus regard that as the proper classification.

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*Carmona, Leçons sur l'etiologie et la prophylaxie de la fievre jaune, Mexico, 1885.

†Gibier, Gaillard's Medical Journal, New York, 1889, Vol. VII, p. 130.

‡Finlay, Annual Report, United States Marine-Hospital Service, 1889, p. 229.

§Kinyoun, Annual Report, United States Marine-Hospital Service, 1889, p. 105.

‖Sternberg, Report on the Etiology and Prevention of Yellow Fever, 1890, p. 13.

¶Havelburg, Public Health Reports, Vol. XII, 1897, p. 795.

In February, 1896, Sanarelli[*] discovered the "*bacillus icteroides*," and since its announcement to the scientific world the opinions of competent observers have been divided as to the true etiological rôle of this organism.

Sanarelli himself is unable to find this bacillus in all of his cases—only in 58 per cent—but an ingenious explanation of this lack of success in constantly finding the bacillus is adduced by Sanarelli, who states that in laboratory experiments icteroides are quickly overrun and killed by the common pus organisms, the colon bacillus, and other bacterial inhabitants of the intestines. He therefore concludes that these last-mentioned organisms, having gained entrance to the circulation through the destruction of the natural barrier by degenerative changes wrought by icteroides, proceed at once to kill the first invaders.

By inoculations he has produced a disease in animals very closely resembling yellow fever, but the analogy is hardly strong enough, nor do the symptoms and pathological changes differ sufficiently from those produced by other organisms, notably bacillus "X," Sternberg, to warrant the conclusion that the disease actually has been produced. He further states that serum from convalescents or from yellow-fever cadavers produces only slight agglutination of bacillus icteroides. Other observers[†] have made much bolder claims for the agglutinative powers of serum from the above sources. Strange to say, antidiphtheritic serum produces rapid agglutination of the bacillus, which would indicate a close biological relationship between it and the Klebs-Loeffler bacillus. Indeed, there are points of resemblance in the manner in which the infection of yellow fever and diphtheria spread. Typhoid serum also produces this phenomenon but partially, and, as would naturally be expected, colon serum and that from normal man and other animals produces no effect.

Serum from a convalescent from yellow-fever possesses no curative action when injected into the guinea pig simultaneously with the minimum fatal dose of icteroides, but 2 c. c. of the same serum administered twenty-four hours previous to the minimum fatal dose seems to confer immunity; at least, the pig does not die.

A horse has been immunized to the bacillus icteroides and 0.5 c. c. of his serum will give to the guinea pig the immunity above mentioned under the same conditions, and even after forty-eight hours have been allowed to elapse 2 c. c. will save the animal.

The following is the result of treatment of cases of yellow fever with Sanarelli's[‡] antiamarylic serum, conducted by himself. He used the serum of a horse inoculated with gradually increasing quantities of the icteroid bacillus for eighteen months. At San Carlos do Pinhal, Brazil, he treated eight cases with subcutaneous injections, the total quantity administered varying from 15 c. c. to 65 c. c., with a mortality of two. Another series of fourteen cases was treated by the "intensive method" or intravenous injections, four of whom died.

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[*] Sanarelli, Annales de L'Institut Pasteur, XI, p. 438, 1897.

[†] Archinard, New Orleans Med. and Surg. Jour., Vol. L, p. 455, 1898.

[‡] Sanarelli: Annales de l'Institut Pasteur, Vol. XII, p. 348, 1898.

Dr. Seidl had previously treated eight cases in San Sebastian Hospital, Rio de Janeiro, with serum sent him by Sanarelli, with four deaths. During the treatment of the cases at San Carlos, three convicts were stricken with the fever in the local prison. All the other inmates received prophylactic inoculations of the serum and the threatened invasion of the institution was promptly arrested, no more cases appearing. Unfortunately, no mention is made of the number thus protected, nor have we any knowledge of their previous history, although it is stated that many of them were foreigners; that their physiological condition and the hygiene of the prison left much to be desired, and that they ought to be considered as very susceptible to the disease.

The apparent lack of success that has thus far attended the treatment of yellow fever with antiamarylic serum constitutes no argument against the bacillus as the cause of the disease, because, as is well known, there are yet many diseases in which the microbic cause is incontestably established, but for which we are still unable to procure a specific curative serum.

If all the postulates formulated by Koch as necessary to prove the etiological rôle of an organism in the production of a disease have not been fulfilled by bacillus icteroides in connection with yellow fever, the demand of one is possibly met in the fact that this organism has not yet been found, save in the bodies of those sick with or dead from the malady.

If we are not at all prepared to accept the claims of Sanarelli in their entirety, the future, nevertheless, is bright with hope.

Many able and conscientious investigators are working to verify the researches of Sanarelli, and should they not be successful in their aim there is every reason to expect that their labors will sooner or later solve the vexed problem.

ON THE VALUE OF THE AUTOPSIC FINDINGS IN CASES THAT HAVE DIED OF SUSPECTED YELLOW FEVER.

By P. A. Surg. EUGENE WASDIN.

The history of this acute infectious disease establishes clearly the fact that it has been, and continues to be, of absorbing interest to all who have come in contact with it, because of the obscurity which has always enshrouded its etiology, the comparative difficulty in diagnosis, and the varying severity of the disease during different epidemics and in different localities. Naturally the question of its diagnosis, upon which depends very frequently the safety of large communities from its ravages, and, per contra, the integrity of commercial relations between a suspected place and other reactive centers, is a most important one. For many years the external appearance of the dead body, and that of the internal organs, has been accounted of great value to the diagnostician; and it is of the comparative value of such appearances to one called upon to make a decision under such conditions that this paper treats.

The yellow-fever cadaver has assuredly a most characteristic appearance. All bodies dead of the disease bear a close resemblance to each other; indeed, it would not be difficult to make a diagnosis, other facts being favorable thereto, from the cadaver alone. The body is usually quite rigid, this change in the muscles coming on early and persisting. The color is invariably more or less intensely yellow, and is due to a mixed hepatogenous and hematogenous jaundice. The entire skin is tinted, the scalp usually giving a startling contrast with the parted hair; the whites of the eyes are yellow, the change taking place in the conjunctivæ early in the disease, the scleræ becoming tinted later. This yellow tint is always contrasted with the deep purple discolorations from hypostasis which quickly appear in the skin of the dependent portions of the body after, but which frequently appear before, death. It is at the edges of these hypostatic areas that the mixture of biliary and blood jaundice is particularly noticed, as a muddy, thick, grayish-yellow tone. Hypostasis is common in all cadavers, but particularly is it prominent in this disease. It is not confined to the lower portions of the body, as the buttocks, loins, and shoulders, but invades the neck, chest, ears, and face; the genitals, as a rule, and the finger and toe nails are of a deep purple color. This discoloration occurs quickly and is prominent in an hour post-mortem. The pupils are usually dilated; the tongue foul, or, like the gums, bloody; the anterior nares are caked with blood. This is a picture of a typical cadaver, and the appearances may be accentuated or softened, but the characteristic ensemble will be present in all. During my recent stay in the city of Havana, I was called upon by Dr. Curto, of the staff of the military hospital, Alphonso the XIII, to decide the presence of yellow fever in a cadaver three hours post-mortem. The body was quite yellow and there was hypostasis, but it lacked the characteristic appearance, and section showed indubitable evidence of malarial toxemia of long standing.

My experience, from autopsies of cases of malarial fever in the South, teaches that there are externally many points of resemblance in them to the yellow-fever cadaver, and at times I feel assured the decision between them would be very difficult or impossible. Dependence must then be placed upon the conditions found in the internal organs. Section shows deep yellow tinting of the superficial tissues and the peritoneum; a dryness of these tissues; a glazed appearance of the intestines, which are dry and sticky to the touch, and a deep-tinted peritoneal fluid. The organs are of a yellow tint, ranging from light to deep saffron. The omentum is deeply congested, the dilated, purple veins contrasting with the general tint. The spleen is usually of normal size and appearance; any deviation suggests preceding or complicating disease. The kidneys are always congested and swollen; the stellate veins of the capsule are prominent; the capsule itself is not influenced by the disease; frequently there are extravasations upon the cortical surface. Incision of the organs shows congestion of the renal veins, yet the general appearance is pale; the cortex is swollen, its markings usually obscured, and at the bases of the pyramids of Malpighi there are seen pale yellow fatty areas. These are very generally seen, and in cases of long duration a general fatty appearance is present.

I would attract especial attention to these fatty areas about the base of the pyramids within the cortex, for they can be seen when the kidney otherwise appears free from fatty change. The adrenals are normal. The urinary bladder is usually empty from anuria; its mucosa may present extravasations; in one case only have I known bloody urine from such extravasation. The mesentery is always typically congested, yet I have but rarely seen extravasation in its layers; the congestion is more marked in the reflection upon the duodenum. The liver, long considered the pathognomonic organ, may or may not be normal in size, but any deviation from the normal I consider dependent upon some other cause, for if the histology be considered it will be seen that upon the increased amount of blood in the vessels depends any increase, while the termination of the disease must anticipate noticeable decrease in its size from absorption of the fatty detritus. I have usually found the organ normal in size. The gall bladder is generally empty, owing to intraabdominal pressure from vomiting and decreased secretion, but may contain a normal amount of bile. The color of the organ varies from a light buff or "boxwood" to a dark brown, this seeming to depend upon the amount of congestion, the left lobe and upper portions being as a rule lighter in color than the right and more dependent portions, the posterior surface being a dark blue from stasis. At times this fatty appearance is diffuse, and again there may be only plaques of yellow upon the surface or throughout the organ.

A frequent appearance is that of the so-called "nutmeg" liver, the yellow points contrasting with the red lines about them. Upon section, the liver, if not the subject of preceding disease, presents a normally firm resistance; is of firm consistence; at times friable and dry; of a pale yellow color, and imparts to the blade a greasy stain. The portal vessels are full of dark fluid blood, which quickly changes to carmine on exposure to the air. The venous radicles are distended, the adjacent parenchyma showing fatty change, and this contrast results in the "nutmeg" appearance. The smaller bile ducts are empty. The capsule is normal. The vessels of the stomach walls are congested, also those of the omental reflections. The stomach may contain more or less blood-stained fluid, which, if exposed to the acid secretion for some time, may have the "coffee grounds" appearance. Frequently the content is a thick, glairy, grayish mucus which clings to the mucosa. The mucosa itself is invariably thickened, swollen, and presents numerous patches of extravasation and shallow erosions. While the entire membrane may be affected, the changes are more marked on the anterior surface and near the pylorus, the membrane here presenting a deep port-wine stain from diffuse extravasation, and often evidence of free hemorrhage.

If many hours have elapsed between demise and autopsy the membrane will be found much softened and with many erosions from post-mortem change. The vessels of the duodenum are engorged; the mucosa is swollen, eroded, and hemorrhagic; in some instances it contains black, grumous blood from which the stomach was free. The mucosa of the entire canal may present evidences of ante-mortem congestion in the form of minute extravasations. In the female there may be extravasations in the ovaries, or in the mucosa of the tubes and uterus. The vessels are prominent on the surface of the diaphragm. Within the thorax the general yellow tint prevails, there being nothing notable about the lungs save congestion; the pleuræ frequently present ecchymoses; the pericardium also is frequently ecchymotic both visceral and parietal; the heart is usually in diastole, or the left ventricle may be rigidly contracted from change in the muscle, the right being always dilated with dark fluid blood. There is always present a very notable congestion of the vasa vasorum of the great vessels at the base of the heart, these minute vessels forming a delicate tracery over their serosa and upon the walls of the auricles, with at times minute ecchymoses. I deem this a very constant and characteristic appearance. The heart muscle does not show fatty changes very often to the unaided eye. The fluids of pericardium and pleuræ are yellow. The changes in the brain and its membranes are those of intense congestion, the fluid of the ventricles being yellow, and there may be extravasations. Such are the findings in a typical yellow-fever cadaver.

It is sometimes said that a yellow-fever autopsy is a bloodless one, but this expression must have arisen because of the limited scope of many hastily made sections, which consisted in an exposure of the liver and its incision, the extraction of a kidney, and the exploration of the stomach in situ. In reality, the full influence of the toxin is felt upon the vasomotor system, and results in an incomparable congestion of the vessels of the abdomen, and when complete the section presents an appearance quite the reverse. A study of the histopathology of the organs must be limited to the examination of fresh sections from the liver and kidneys, for in these the fatty changes are best seen; the liver cells are more granular, stain more faintly, and contain numerous fat droplets; those of the kidneys lining the tubules, especially of the cortex, are also filled with drops of fat. These gross changes are readily detected, and if facilities are at hand they should be sought for. But the importance of an immediate diagnosis will have long passed before the finer histologic changes may be observed. I have said that the above appearances are constant in the cadaver of yellow fever. The question then arises as to their diagnostic value. Is it possible to arrive at definite conclusions from an isolated case presenting all of these signs? Would we be justified in such cases either in withholding quarantine protection from a community or in initiating quarantine to the possible detriment to commerce? The last phase of the question is a most important one, and at times exercises as much influence as the first.

From recent observation I feel safe in asserting that it is not possible to diagnose this disease from the appearances and the gross microscopic findings alone. I do not undervalue their importance, when taken in due consideration with the history of the case, the clinical charts, and the history of albuminuria, in assisting to form an opinion, but in the absence of these accompanying facts they are not sufficient to name the disease, although a diagnosis may be safely ventured in the absence of any other known cause of infection. Just here I will venture tentatively upon the question of etiology, as having a direct bearing upon what has been said. All observers in this field have recorded the presence of the bacillus coli communis in its many forms in the blood of patients living, and more freely in the blood and tissues of those dead from yellow fever. Sternberg in 1889 discovered, among other forms in the tissues of such patients, a bacillus of such peculiar physiologic and vegetative characteristics that he assumed for it a distinctive position among these organisms and, from its influence upon animals, a possible etiologic value in this disease. This was the Bacillus "X." In 1897 Sanarelli, of the University of Montevideo, published the discovery of a bacillus supposed to cause the disease—his Bacillus "Icteröides." These organisms present many similar features of growth and chemic reaction, yet there are sufficient distinguishing characteristics to insure them separate places in the group of colon organisms, for, during my observations upon these and other organisms from yellow-fever cases, it became evident that the former belonged to this group and it appeared probable that the bacillus of Sanarelli was also to be classed among them.

On September 28, 1897, it was my privilege to observe a case of yellow fever at the isolation division of the Marine Hospital Service detention camp at Fontainebleau, Miss., in the person of one Goodrich, and from cultures from his blood, on the fourth day of the disease (which was well marked), to isolate a bacillus, which corresponded to that of Sanarelli, from a contaminating colon bacillus. This was designated Bacillus "Goodrich," and was esteemed the first organism isolated after Sanarelli in this country. Later, in the city of Havana and in concert with my colleague, P. A. Surg. H. D. Geddings, United States Marine-Hospital Service, this bacillus was isolated from a number of cultures taken at autopsy from cases in the isolation hospital in New Orleans during the epidemic of last year. Besides the organisms isolated by us from these native sources, it was our privilege to study a limited number of cases of yellow fever in the military hospitals of Havana, and in 60 per cent of these we isolated the same bacillus. In all of these instances this organism maintained its distinctive characteristics from the Bacillus "X."

Experimental inoculation with these organisms were usually fatal to animals, which exhibited more or less pronounced, rapid, or prolonged symptoms of intoxication, but necropsy always gave similar appearances in the different organs. As an example, I give the notes from an autopsy. "Pig No. 2, white female, weight 525 grams, was injected intraperitoneally with 7 c. c. of a twenty-four hour bouillon culture of Bacillus 'Goodrich,' at 3 p. m. on the 9th of February, 1898. On the morning of the 10th the animal exhibits evidence of distress, does not eat, remains crouched in cage, abdomen tender; temperature, 37.3; respiration, 80. At 3 p. m. the animal is quite ill and has lost 42 grams in weight. At 9 a. m. on the 11th it died. Necropsy immediate. Body still warm; heart first exposed, in diastole and full of dark fluid blood; the vasa vasorum distended over the great vessels at the base; pericardium and fluid slightly tinted. The liver is congested with numerous plaques of a yellowish-white fatty appearance; when incised this fatty appearance is general. The spleen is slightly increased in size and congested. The kidneys much congested and swollen. The urinary bladder contains 6 c. c. of urine which, by the cold nitric acid test, gives a dense 'ring' of albumen, and which is also shown with heat and nitric acid. Peritoneum not inflamed, some injection at the point of puncture to left of median line; in the left iliac fossa there is a small quantity of cloudy fluid localized. Mesentery normal save an intense engorgement of its vessels, especially in its duodenal reflection. In the stomach the mucosa is congested, thickened, and softened, especially about the pylorus; that of the duodenum much congested with numerous small extravasations, but no free hemorrhage. Cultures from blood of organs and from the fluid from the fossa give after twenty-four hours colonies only from the latter. This is a pure culture of the inoculating organism. After forty-eight hours tubes from the left pleural fluid also exhibit colonies of this organism in pure culture, the spleen also giving a colony from contamination. Cover preparations show only a small characteristic rod in pure culture from the fluid in the iliac fossa."

In this case there was no free blood in the stomach or bowel, but in the very next of my series there is this note: "Mucosa (stomach) injected, and near the pylorus there are ecchymoses, and at one point at least there is free hemorrhage, which has stained the food mass a dark or black color; this looks like 'coffee grounds.'" This experience has been that of many other observers. These organisms elaborate a toxin which exerts a characteristic and powerful influence upon the vasomotor system, as evidenced in the intense engorgement of the vessels, the gaseous, toneless pulse, and the full diastolic heart, prior to and post-mortem; also in that rapid metamorphosis of the albuminoids of the highly organized cells of the liver and kidneys. The intention is not to contrast these organisms, but to accentuate the fact that there is no constant sign at these autopsies by which we can name the particular one which has produced the disease.

Here I will revert to the subject proper, the value of these post-mortem appearances in the human body. And again I must refer to notes kindly furnished me by Dr. B. E. Baker, of the army general hospital at Key West, Fla., in order to illustrate their value. The U. S. S. *Yankee*, cruising on the southern coast of Cuba during June, 1898, entered Key West Harbor. She sent to hospital a seaman ill for one week with appendicitis. Her officers later stated that a few Cubans had been entertained on board during this time, and that several boats' crews had been sent on board of captured vessels for the purpose of destroying them, but that no baggage or effects had been allowed on the vessel excepting four dogs and a few machetes. On the third day after entering hospital and the second after operation for appendicial abscess, the patient developed high fever, became delirious, and died on the fourth, the entire illness being about ten days. Prior to death the acute exacerbation (the temperature having fallen to normal after the operation) and the mental symptoms attracted attention. The skin was noticed to be jaundiced and suffused, as were the eyes. Urine contained no albumen at this time, but found to contain it after death. At autopsy the general appearance of the body impressed the operator, Dr. Baker, with the probability of its being the subject of yellow fever, and I was asked in consultation. After a careful examination of the body and organs I concurred in the diagnosis of yellow fever.

Necropsy (made five hours post-mortem): White male adult, poorly nourished; rigor marked; conjunctivæ slightly jaundiced; pupils normal; post mortem lividity on back and neck and dependent portions of the body, on scrotum and prepuce; the face, neck, and anterior portions of trunk a bronze-yellow color, not so marked on the legs. On section there is about 12 c. c. of clear bile-stained fluid in the pericardial sac; the membrane contains a few ecchymotic spots in its reflection over the diaphragm; the visceral reflection also is ecchymotic, and presents extravasations of blood well marked at the base of ventricles; the vasa vasorum distended; the heart normal in size; the left ventricle contains small amount of soft blood clot; the right auricle and ventricle distended with dark fluid blood; valves competent; muscle is pale and yellowish; aorta tinted, some atheroma about valves. The pleura shows old adhesions; the lungs are normal. The abdominal cavity is dry; the intestines sticky; the mesentery and the omentum show ecchymotic patches; the glands are enlarged. The spleen is normal in size and color. The kidneys are slightly increased in size, congested, the stellate veins of the capsule well marked; the inner edges of the cortex, near the bases of the malpighian pyramids, show a yellowish tinge; supra-renal bodies normal. The liver is normal in size, of typical "nutmeg" appearance, with lemon-yellow areas and spots scattered over the surface; the gall bladder contains 45 c. c. of thick greenish-black bile. On section the liver presents a typical "nutmeg" appearance, and much congestion. The stomach is somewhat dilated, and contains 250 c. c. of brownish-black fluid with brown granules; the mucosa is congested throughout, but especially on the posterior wall near the cardiac extremity. (When washed there were great plaques of deep wine-colored extravasation and numerous erosions.) The mucosa of the duodenum is ecchymotic and there is free hemorrhage in the form of black vomit. The last inch of the ileum is bound down by adhesions, as are the caput coli and the cœcum. On freeing the gut a small abscess cavity is seen between it and the abdominal wall, in which is the vermiform appendix, with a slough in its distal portion, the upper two-thirds being normal. (This cavity was drained through an incision through the abdominal wall.)

In this case there was no doubt in my mind that death had been caused by infection with one of the organisms of the group already named; but with which one? Here there was an acute appendicitis, with localized abscess and perfect drainage. Was it clear that death had taken place from a general infection from the colon group? Not at all, for this patient had been possibly, or probably, exposed to the infection of yellow fever through the presence on board his ship of persons who may have conveyed infection in their clothing. The time elapsed since such possible exposure was about the incubation period of the disease. If we assume that the fever developed in hospital, it must have been contracted on the ship, since there has been no yellow fever in this city during this season. In this remarkable case, remarkable because of the element in it of serious possibility, amounting to probability, of exposure to the infection of yellow fever, contrasted with the fact of local, if not a general, infection with the bacillus coli communis, I concurred in the diagnosis of death from yellow fever honestly, for this was a yellow-fever cadaver, as we know them from external appearance and anatomical facts. However, I am now convinced that it was simply an intoxication from autoinfection with some member of the colon group of organisms. For, notwithstanding the fact that the crew of the *Yankee* was composed of young Northern men, the New York Naval Reserve, and that the surgeons, nurses, attendants, and neighboring patients were reagents, there has been no sequel to the case, nor is it reasonable to assume that this seaman, ill in his cot from appendicitis, should have been the only one of all the reagents on this ship to have contracted the possible infection.

The city of Key West is the base of naval operations against Spain. Its poor sanitary condition, the presence of a large number of nonimmune residents, and the necessity of keeping the base open, all seemed to me to demand the diagnosis which we made; for under the circumstances the only harm possible would be the restraint placed upon the inmates of the hospital for the prescribed time and extra vigilance upon the part of the medical officer on board the ship. Only a few minutes after the post-mortem one of the medical officers, a reagent, asked me: "How much danger of infection have I risked from my presence at the operation upon this case and my having visited it several times since?" I replied: "None, provided this man has not come into contact with the infecting agent of yellow fever." Moreover, I felt willing to assume the responsibility, provided also all blame, in continuing the routine of the hospital without other restraint than strict vigilance until some sequel demanded its isolation. However, was the autopsy in this case of material assistance of itself? In the absence of any history of possible infection, could anyone familiar with the appearances in the organs of animals killed with the organisms mentioned, and comparing these with those found in yellow-fever organs in man, have unhesitatingly decided in this case? Yellow fever clinically studied has impressed many observers, since I have heard it frequently expressed among the profession in Southern cities that it is a disease in which probably two etiologic factors are present—the primary, or external agency, giving rise to the initial symptoms of the disease, and a secondary, or internal agent, of autoinfection.

Is it not possible, from what has been shown, that the autoinfection may be productive of the autopsic appearances? This view of the disease is reasonable, but not yet proved; nor will it be until the indubitable cause of yellow fever is discovered; that is, an agent which not only can give rise to the appearances of yellow fever, especially post-mortem, but can, as in the case of bacillus diphtheriæ, give rise to an acute dissemination of the disease among those who are reagents. This has not been demonstrated either in the case of the Bacillus "X" or of Bacillus "Icteröides." We should not hastily decide upon the etiologic value of an organism, so closely allied to the colon group as are the two named, from the influence exercised upon the sick by the exhibition of its antiserum, but depend rather upon its power to reproduce the disease, "catching" from person to person and of the antiserum to prevent such infections. Finally, I would suggest that typical autopsic findings should always be regarded with suspicion and demand immediate investigation of their cause. Should there be or not any local center of autoinfection, there should be an investigation of the immediately preceding history of the patient, and should there prove to be evidence of exposure to infection of yellow fever, and should the clinical charts and history present the evidences of the disease which we have learned to recognize, then, and only then, can the information gained post-mortem be of decisive value to the diagnostician.

TRAIN INSPECTION.

A contributed article by Surg. H. R. CARTER, prepared at the close of the epidemic of 1898.

COMMUNICATING, NEUTRAL, AND DRIFT TERRITORY.

It is not proposed to go into the general question of passenger traffic on railroads from and contiguous to a place infected with yellow fever, but simply to present a few points in train inspection and its necessary adjuncts, which, in spite of the fact that they have been in use more or less completely by this Service since 1893, and, indeed, in principle since 1888, seem to be not thoroughly appreciated.

To take the matter generally, let us suppose A to be an infected town,* with lines of railroad A. N. and A. S. running the one through to northern points and the other to a southern (infectible) terminal. Let the country around this town as far as X hold direct communication with it after quarantine is laid, and all beyond establish quarantine. Let that district not farther than V have held communication with it under such conditions that it has people in it who have recently been exposed to infection in A, and is suspected of containing foci of infection as yet unknown.

The problem is to organize the train inspection on these two roads for passenger traffic, through and local.

RELAY.

The relay of train crews should take place at R, the last station in the communicating territory. This is not absolutely necessary, as any siding near this limit will do—preferably on the proximal side. If an unoccupied siding be unobtainable, a small place certainly not infected, and kept inspected, will do.

If the communication between the city and the territory between it and X is unrestricted, there is obviously no need of an inspection on the train up to this place, because an inspector is needed only if there are restrictions to enforce. If this communication be hedged around with certain restrictions, however—"daylight," "disinfection of baggage," etc.—this inspection is needed to enforce it.

Passenger traffic beyond X must be allowed only under certain restrictions, and hence subject to inspection.

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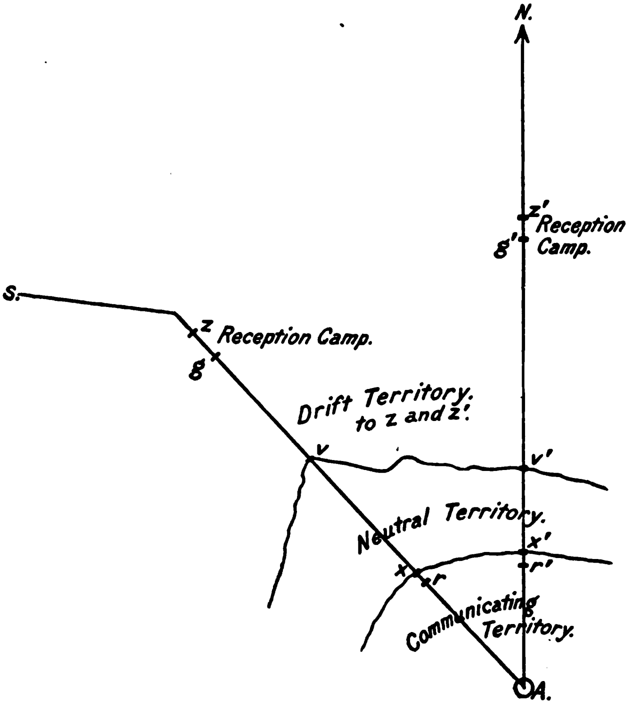
* See "Illustrative Diagram," page 442.



Illustrative Diagram.

RESTRICTIONS ON PASSENGER TRAFFIC.

This divides itself into permanent and temporary—that is, "pending investigation."

From A to X to be determined by the nature of the communication agreed. Free communication to be allowed between all places between A and X if under the same rule of communication.

(1) No person to be allowed to pass from A north of X save immunes, etc. They would go only into infectible quarantined territory. There is no question, then, of "through passenger traffic" on this road.[1]

(2) No passengers to be allowed to pass north of V save immunes, etc., "pending investigation." For this the reason is obvious.

(3) No intercommunication to be allowed between places between X and V "pending investigation." This is because we believe some place in this district is or may be infected, and that all are not. Obviously, then, until we can differentiate the clean from the infectep places communication from the latter to the former may infect a clean place.

(2) and (3). Taken together mean that, "pending investigation," no passengers are allowed to board trains between X and V, and that the north-bound trains go empty into and through this district, unless, indeed, the train for the upper end of the road be made up north of this district.

When the investigation has shown, if it does show, that there is no focus of infection beyond X, this neutral territory disappears (or will disappear if sufficient pains are taken with quarantine), and the restrictions against travel therefrom enumerated above should be removed.

The conveyance by rail of infection beyond X is sufficiently provided for by the above rules. Now we believe that there is no infection or persons recently exposed to infection north of V, yet there is, or at least may be, always a certain number of people who will, by private conveyance or by walking, pass from south of V to places north of that point. This condition and the danger from it will be considerably increased if by going a moderate distance beyond the quarantine lines at V they can board the train and proceed to any destination they elect. This, then, is to be guarded against. It is done, so far as the train inspection is concerned, by requiring a "health certificate" of persons boarding trains beyond V. This "health certificate" is a misnomer and should be a "certificate of residence," because it witnesses that the holder has resided in a locality not quarantined against for not less than —— (usually ten) days.

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[1] It is a good general rule that people living in communicating territory, if infectible, should not be allowed freedom of travel in clean infectible territory. This is on account of the risk of foci of infection being established in the former and not being immediately recognized. Still, if we know that a place is free from infection, the fact of it holding direct communication with an infected place does not of itself render those leaving it liable to convey infection; they could be allowed to travel on a certificate of residence. Residents of Bay St. Louis, which place held direct "daylight" communication with New Orleans (but which was known to be free from infection), were allowed to enter Florida on certificates of residence, and this action was safe.

FORM OF HEALTH CERTIFICATE.

OFFICE OF BOARD OF HEALTH,
———, 189—.

Health Officer ———.

To whom it may concern:

This is to certify that Mr. ——— has given satisfactory evidence to me that he has been in ——— not less than ten days, and to the best of my knowledge and belief he has not been exposed to the infection of yellow fever, and has not been in any infected or suspected locality for ten days.

Description: Age, —— years; weight, —— pounds; height, ——; complexion, ———; hair, ———; eyes, ———.

——— ———,
Health Officer.

Signature: ——— ———.

Obviously this excludes persons recently from south of V and gets rid of the transportation by rail of those going by private conveyance from this territory.

We can generally depend on the small towns and stations next to V forbidding people liable to convey infection going to them to remain, while they will frequently make no effort to prevent such people going to them to take the train, and this prohibition to board the trains acts to increase the vigilance of these places against the entrance of suspects. Also the knowledge that they can not board the trains even at places north of V enormously limits the choice of places to which people can go, and is thus very effective in preventing them from attempting to pass the quarantine lines.

How to insure that these certificates are true is a problem not to be considered here. Unless much pains be taken they may be very misleading; yet they can be made of great value.

From the reasons given for establishing this inspection it is clear it need not extend indefinitely up the road. It must cover the distance to which people south of V will go by private conveyance; it need not go beyond.

Let us suppose Z is beyond (certainly beyond) this distance. Health certificates (certificates of residence), then, will be required of all boarding trains between V and Z, and the inspector on the train must go so far and need not go beyond that point. This inspection will begin at A or at R, according to whether the communication with A of the "communicating territory" is limited or unlimited.

This territory into which people may come by private conveyance from quarantined territory has been called the "drift territory." Of course it may not exist, as there may be no neutral territory; an efficient cordon around the quarantined district does away with it. I have not judged it safe to dispense with it in any epidemic I have seen, although it might have been dispensed with at Franklin and during the latter part of the quarantine at McHenry.

(4) Passengers from points between V and Z shall be allowed to board trains provided they have not been in quarantined territory for —— days—i. e., those who can produce proper "health certificates."

(5) Beyond Z there should be no restriction in passenger traffic.

If this place V be at the crossing points of the north and south bound trains, it will be very convenient; one tier of inspectors will be enough. The same will be true if it be south of the crossing point, as they can go up on the north-bound train and return on the south bound, simply stepping from one train to another.

Notice to the railroad that only those presenting proof (generally specified as "health certificates") that they have not been in any place quarantined for —— (ten) days are to be allowed to board trains as passengers between V and Z will result in the ticket agents along the lines demanding health certificates as a prerequisite to the sale of tickets. In general, then, those on board the trains will have the required evidence. If there were time for the train inspector to examine critically into this evidence prior to boarding it would be ideal. In general this causes unjustifiable delay to trains, and the ticket agent, where such exists, has already passed on the matter. A certain number, however, will be found boarding the train between these places who do not present satisfactory evidence on this point, and therefore can not be transported to other clean places. What is to be done with these people? The practice recently—and I think the proper disposition—is to keep them on the train to the end of the inspector's run. If this be the meeting point of the north and south bound trains, he can take them across to the south-bound train and carry them back. If the end of the run be not the meeting point of trains, there must be here a building or tents with necessary equipage, under guard—a reception camp or guard tents—where these people can be cared for in isolation and sent south with the inspector on the south-bound train. These people had best, if the inspector believes that they have been exposed to infection, be taken to detention camp. This was done for the few suspects of McHenry, who were very willing to go. Failing this, as was done most generally, they are taken back to the station at which they boarded the train. The health authorities having jurisdiction over this place should be notified in the meantime, and if there is good reason to believe that these people have illegally left the quarantined territory it will be found that they are by these health authorities forbidden to remain at this place and that they either ask to go to a detention camp or to go back to their homes in the quarantined section. It is this bringing back of suspects to the place at which they boarded the train which makes the ticket agent carefully inspect the evidence (health certificate) which these people present. After this thing happens more than once, there are very few roads which will retain such an agent without a very satisfactory explanation. I have found that after they come to appreciate this and have had a little experience ticket agents become most valuable allies in train-inspection service.

So much for the relays, the restrictions on passenger travel, and the local limits of the work of the officer who inspects the train.

INSPECTION OF TERRITORY.

It is obvious that when we accept certificates of residence (health certificates) from any place between V and Z we imply that this place is not infected. Also, that when we require a certificate from such a place we imply that persons capable of conveying infection may be at that place, if only to board the trains. These persons may possibly develop fever at this place and infect it. The country, then, between V and Z (drift territory) is predicated as clean, but liable to become infected. It is necessary, then, to have at all times authentic information of its sanitary condition, and it should be kept under inspection, to see that no place in it becomes infected without our knowing it. This is absolutely essential; else we will be taking health certificates from infected places and allowing people from such places to travel on them ad libitum, spreading infection.

This inspection of territory, then, is as much a part of train inspection, or rather regulation of passenger traffic on the lines from an infected town, as inspection of passengers on the train, which is imperfect without it.

It is obvious that the limits and, indeed existence, of a drift territory depends not on distance, but on the fact that persons from the quarantined territory pass up into it to certain distances unguarded, or insufficiently guarded, lines of communication.

If this, by proper quarantine measures, be prevented (by cordon or otherwise), there is of course no drift territory—a condition which seldom obtains—and, in proportion as it is rendered difficult, so will this territory become a small factor in our train inspection.

It will be seen that in some points this "drift territory" is the converse of the "neutral territory." From the latter we allow no egress until inspection has shown it to be free from infection and from persons liable to develop infection, when it indeed ceases to be neutral territory and inspection for that purpose ceases. For the former we allow egress as long as inspection shows that no place in it becomes infected, and inspection is to continue for this purpose as long as the territory keeps clean. In the one, inspection will remove or confirm suspicion of infection believed to exist. In the other, it is to confirm or deny a belief in the freedom from infection.

For the territory inspected, the inspection of neutral territory is frequently a great commercial advantage and generally welcomed; it is already in quarantine, and this inspection may relieve it. The inspection of the "drift" is absolutely essential for the sanitary protection of other places, but it may lead to quarantine of places in this territory, and is not generally regarded with special favor by the place inspected. Of the two, it is the more necessary.

Obviously it need not extend beyond Z, yet it may be (and usually is) advisable somewhat beyond. The inspector for this work, as for that of neutral territory, must be possessed of certain qualifications.

First. Must be skilled in the differential diagnosis of yellow fever, and of such reputation therein that his diagnosis of yellow fever, positive or negative, will be generally accepted, so as to leave as few disputes as possible as to the nature of the disease which he has pronounced on. No one's diagnosis will be universally accepted by the inhabitants of the town in which he declares yellow fever. Yet much opposition can be disarmed by conservatism, carefulness, and absolute good faith.

Second. He must be immune to yellow fever. Else should he discover an infected place his usefulness as inspector is destroyed, as he may not go from such a place into clean territory. Should he (nonimmune) expose himself to infection and fail to recognize the disease, he becomes a source of danger to the community which he has inspected.

For a road of this nature, running only to infectible territory, this system is complete. It requires (1) relay of train crews, (2) inspection of territory, (3) train inspectors, (4) reception camp (guard tents).

All of this is necessary for a complete train inspection. Without the relay, crews of trains are liable to convey infection. The inspection of territory is needed to determine from what places people can be allowed passage. The train inspector is needed to prevent other people than those allowed from taking passage. The reception camp is needed to enable the train inspector to carry out his instructions without undue interference with the schedule of trains.

For the road A. N. it is obvious for the local passenger traffic that the same conditions exist as for A. S., and we establish our relays at R′, mark X′, V′, and Z′ as the limits of the "communicating," "neutral," and "drift" territory, and establish our inspection of territory, reception camps, and train inspectors just as needed before.

But as this road runs through to noninfectible territory which is not quarantined, we can allow through passenger traffic on it from A to Northern points. So far as the origin of passengers is concerned this can take place without any restriction, but we must provide that they do not stop in infectible territory; do not hold contaminating intercourse therein while passing through; do not return thereto until the period of incubation has passed, and do not then return with fomites. Certain restrictions are necessary, then, affecting the mode of traveling.

The two first indications are fulfilled by sending the through passenger (refugees), under the care of a train inspector (train guard), who simply sees that they do not leave the train. There is little danger in allowing these people to ride in the same coach with local passengers, because people generally travel in clean clothes.[1] But it is customary to give them a train, or at least a coach, to themselves, and this is best; less to obviate the small risk of infection from the clothing of these people to those traveling with them than to enable the inspector to keep them from eluding him.[2]

Whether the same guard goes through from A to uninfectible territory or several relays of them operate together is a matter of no importance and is determined by convenience. Whether he is only a train guard having charge of these through passengers or whether to this he adds the duties of the train inspector for local traffic also depends upon the train service of the road. There is no need of shutting the windows of the train in passing through places if it be done to prevent them receiving infection from the air of the coach. Whether it is to be done to prevent things being thrown out of the window the guard and local authorities must judge.

At times this guard must be a physician, because if the time en route in noninfectable territory is long and the place is badly infected there will very generally be cases of yellow fever occurring en route. At such times it may be necessary to attach an extra coach as "hospital car." I think the latter will be not often needed. It is but seldom that the inspector for local traffic need be a physician.

Let us note that the functions of this train inspector (train guard) for through traffic are almost in contrast with those of the train inspector on the lines with only local traffic. The duty of the first is to prevent people from quarantined territory leaving the car in infectable territory; he is a guard, and nothing more. The duty of the latter is to prevent persons from quarantined territory boarding the cars in clean territory.

To prevent the return of these people (after we have conducted them north) to noninfectable territory until the period of incubation has passed, and to prevent return at all with fomites, is confessedly difficult; and to do so absolutely is to my mind impossible, while it can be hedged around with safeguards that bring it within the limits of safety given by other quarantine precautions. Of all persons boarding the train to go north affidavits that they "will not return to any place quarantined against A" or "will not return for ten days" is required. These are taken up by the guards or train inspectors. If the second form be the one presented the baggage of the passenger is disinfected and labeled, and a certificate to that effect given him. It is not claimed that an affidavit of this kind gives absolute protection, or even a very high degree of protection. Still, that it does give protection to some degree is shown by the very considerable proportion of those who subscribe to the second form, requiring the disinfection of baggage. This was always complained of; much more, it seems to me, than the inconvenience justified, and was submitted to rather than take the first form of affidavit.

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[1] Passengers believed to be especially liable to convey infection are to be eliminated by the inspectors at A, who examine the affidavits. If found on the cars after they leave the relay, they can be either isolated abroad or returned.

[2] To be consistent, if this separation be required to avoid infection of those traveling with them, the train crew who enter the coaches should be required to be immune or isolated. I do not know of any member of a train crew who is suspected of having contracted yellow fever from his passengers.

A list of the passengers (giving date of arrival and if possible address) going to each principal place of reception of refugees, especially if these be distributing points for passenger traffic south, is made out daily from the list of train inspectors. This is to be furnished to the inspector stationed at such a place and by him furnished to the different ticket offices in that town.

A supervision of the ticket office at this place and requiring residence certificates of those purchasing tickets south will generally be sufficient to prevent most of this "back" travel. This can be supplemented by inspecting the roads leading south from such places. As stated before, it is not claimed that these methods give absolute protection, but it is believed that this is about all that can be done without unduly interfering with traffic, and is within the limits of safety established by other quarantine proceedings.

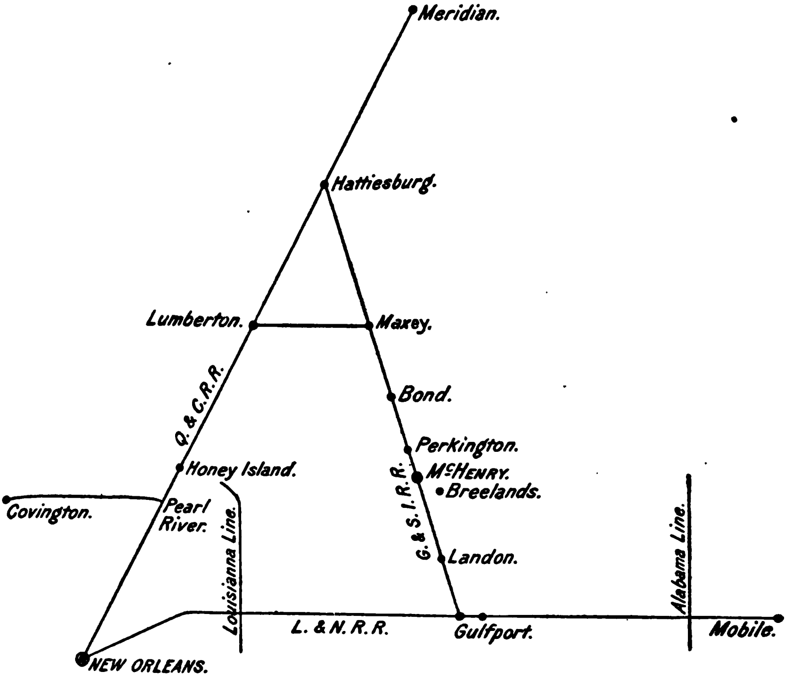
The disinfection of passenger coaches (used for through travel) before coming south again should also be mentioned as a part of this system. For reasons given it is not claimed to be a necessity, but it is advisable as is, though less so, the disinfection of baggage and mail cars either at the same time or at the infected place.—(YOUNG.)

Passenger traffic on lines crossing either of the above lines is obviously to be treated in accordance with the country it runs through and its terminal. If it passes through "drift" territory it will require inspection for local passenger traffic. If it runs to a noninfectable point, receiving refugees, we may allow transfer of refugees to this line if other conditions render it advisable.

It is not pretended that these notes cover the whole subject of train inspection, but it is believed that the points on which I have laid stress, while perfectly obvious, have not been brought out systematically by others writing on this subject.

Let us illustrate the above principles by some of the quarantine measures of this year.

McHenry, Miss.—Yellow fever: Seven cases were reported here the evening of June 9—the first cases, two of them, occurring May 19. A hasty inquiry showed that there had been such communication between this place and the territory along the Gulf and Ship Island Railroad south of Hattiesburg, and from Lumberton to Gulfport, that (1) there were a number of people in this territory who had been at McHenry within the past ten days, who were thus liable to develop yellow fever, and (2) as the fever had been in McHenry over three weeks there was reason to fear that foci of infection already existed in this territory.



Map for McHenry.

From the fever in McHenry being confined to private houses, none being in hotels or boarding houses, both of these risks were adjudged less than had the public houses been infected.

1. All places were quarantined against the town and a cordon thrown about it. There was thus no "communicating territory."

2. Obviously the district south of Hattiesburg, and from Lumberton to Gulfport, inclusive, was "neutral territory." It was accordingly quarantined against "pending investigation," and passenger traffic within this district recommended to be discontinued "pending investigation."

An inspector of territory, Dr. Perkins, of New Orleans, was taken to Gulfport on the morning of the 10th and stationed there. He was directed to make a house-to-house inspection of that place as often as possible, move all who had been exposed to infection out of town, and see that this place be kept clean. Particular pains were taken with Gulfport because if infected it would be a danger to the line of the Louisville and Nashville Railroad, on which in its immediate vicinity were a number of considerable towns. Three other inspectors of territory, Drs. Stone, Tebo, and Römer, were placed on the line of the Gulf and Ship Island Railroad and directed to inspect this above-defined "neutral territory."

3. The line of the Louisville and Nashville, say, between Scranton and the Rigolets; the Gulf and Ship Island from Hattiesburg south; and the Queen and Crescent from Hattiesburg to Honey Island were recommended to be considered "drift territory," and no restriction of travel imposed thereon save that certificates of residence be required of those boarding trains in this section. This part of these three roads then was to be covered by train inspection.

This division I say was the one recommended. The State boards of Mississippi and Louisiana and the board of health of Mobile, however, decided to include the line of the Louisville and Nashville, from the Alabama line to the Louisiana line, in as neutral territory in which unknown foci of infection were suspected to exist and quarantined it pending investigation.

While the writer thinks, as he then thought and said, that this quarantine of the coast was not necessary, it was not unnatural that different people should differ in judgment about the limits of "neutral territory." He saw, however, and can see now, no sanitary reason for holding this quarantine on, as was done by some boards after inspection had shown that this territory was free from fever, and had sufficient quarantine against McHenry and suspected places.

Tents were placed just south of Hattiesburg under guard, to whom any suspects on the trains going north on either road were remanded until the train went south, when they were taken by the inspectors on these roads south to New Orleans or Gulfport, and sent by the inspector on the Louisville and Nashville to the camp at Fontainebleau, where they were taken in charge by the officer in command of the camp. A small number of people from McHenry, attempting to violate the quarantine, were thus handled. Those picked up on south-bound trains also went to Fontainebleau, without, of course, going into the guard tents.

The inspectors of territory soon reported that there were a number of people who had left McHenry within the past ten days at points between McHenry and Gulfport, and reported suspicious cases of fever at Perkinston, Bond, and at Breelands.

In the meantime some of the train crews of the Gulf and Ship Island Railroad which had been exposed to infection in working around McHenry were moved out of Gulfport. Relays were established at

Laudon and Maxie, and the investigation of the coast having satisfied the Mississippi board of health that there was no infection there, quarantine was raised (save by Louisiana) against all save the line of the Gulf and Ship Island between the relays.

Later on, this territory showing no yellow fever and the premises where suspicious sickness had occurred being disinfected, it was declared clean and the relays moved close to McHenry, in which the work was done by a switch engine and special crew. There was then no neutral territory.

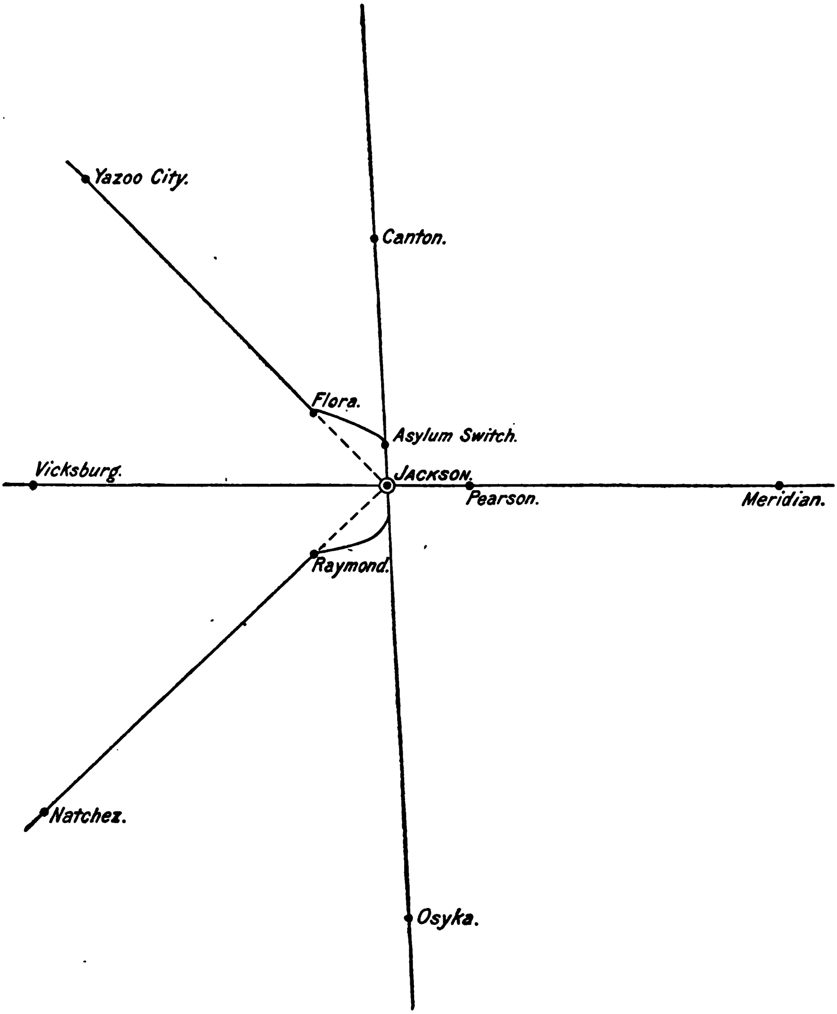


Diagram of railroads from Jackson.

The work at Jackson illustrates the handling of both kinds of roads, those running to southern terminals and those going north. The fever was announced here September 10. As soon as it was announced and prior to the laying of any quarantine a considerable number of people from Jackson left the town and went into the surrounding country by private conveyances.

The counties of Rankin and Hinds, and possibly some others, contained then people recently from Jackson, some of whom had possibly been exposed to infection, though there was no reason to believe that any focus of infection already existed outside of Jackson. Quarantine was then laid against the city. There was thus no communicating territory.

A glance at the map will show that the Illinois Central runs from Jackson north to noninfectible territory, into which these people could be allowed to go with no restrictions so far as residence is concerned.

The Illinois Central Railroad going south; the Alabama and Vicksburg passing through Jackson, from Vicksburg to Meridian; and the two branches of the Yazoo and Mississippi Valley, going, respectively, to Yazoo City and Natchez, led only to southern points and are then analogous to the line AS.

Inspection was established on all these roads—on the Illinois Central Railroad to extend from Osyka to Canton; on the Alabama and Vicksburg from Vicksburg to Meridian; on the other two lines from Flora to Yazoo City, and from Raymond to Natchez. Health certificates were requirèd on these lines from all places between the terminals mentioned, and including Flora and Raymond. The distances traversed by the inspectors exceeded what could reasonably be considered "drift territory," but was selected for convenience to get good stopping places; and on the Illinois Central for being a meeting point of trains, and no inconvenience was caused by requiring health certificates from the small amount of territory covered unnecessarily. Health certificates from Vicksburg, Meridian, Yazoo City, and Natchez were not required.

Relays.—The lines from Yazoo City to Natchez were not allowed to enter the quarantine limits at all. The Alabama and Vicksburg and the Illinois Central both did their business in the city with switch engines. The Illinois Central furnishing special cars for passengers, express, and mails, and the Alabama and Vicksburg for the mail and express; no passengers leaving by this route. In both cases the transfer was made out of town—the one at Asylum Switch, the other at Pearson. No relay camp was required for this work, as the crew of the switch engine remained on their own cars and stayed out of the quarantined district a very short time, about half an hour per trip. Both relays, however, were under guard. Reception camps were established just south of Canton, at Osyka, just west of Meridian, and at Vicksburg—at the eastern limit of the town, and at Natchez and Yazoo City.

The country covered by this inspection, especially that in which the refugees from Jackson had gone, required inspection; and an inspector of territory, Dr. Waldauer, of Vicksburg, was assigned to this work, although subsequent developments required his services elsewhere.

Such people of Jackson as wished to go north were allowed to go, at first, on separate coaches attached to the day through train of the Illinois Central Railroad; and later on, when New Orleans was known to be infected, they went into the same coaches with the New Orleans people, on a special refugee train. A guard was sent with them to north of Carbondale, in Illinois, on the main line, and north of Paducah, Ky., on the branch. These guards were not relayed, making the trip with the refugees to the above destination. The system of relay by switch engine in town is especially applicable to towns which are not terminal for railroads.

New Orleans.—The work at New Orleans might be described as illustrating with small variations all the principles set forth in this préces. We will only mention it with reference to the communicating territory.

The fever was declared here in the evening of September 17. The parishes south of the city and Jefferson and St. Charles elected to hold unrestricted communication with the city, as did St. Tammany (this, however, is believed to be uninfectible, or difficultly infectible, territory).

The country along the line of the Louisville and Nashville west of Gulfport elected to hold "daylight communication with disinfection of personal effects of immunes" with the city. The relays were established at Slidell, Dirt Pits, Laplace, Avondale, and Grand Gulf. No inspection was made for the communicating territory, save along the line of the Louisville and Nashville where the restrictions of "day-light communication" were in force.

On the Louisville and Nashville, the Queen and Crescent, and the Illinois Central Railroad, all going to northern points, through passenger traffic on special trains under relays of inspectors was allowed. On the other three roads local traffic began after passing the different communicating territory, and went on under inspection, no through traffic being allowed.

THE ETIOLOGY OF YELLOW FEVER.

ABSTRACT OF THE REPORT OF THE COMMISSION OF MEDICAL OFFICERS, MARINE-HOSPITAL SERVICE, DETAILED BY AUTHORITY OF THE SECRETARY OF THE TREASURY AND THE PRESIDENT TO INVESTIGATE THE CAUSE OF YELLOW FEVER.

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Under date of November 8, 1897, P. A. Surg. (now Surg.) Eugene Wasdin and P. A. Surg. H. D. Geddings were detailed by authority of the Secretary of the Treasury and the President as a commission to investigate in Havana the nature of yellow fever. Their full report, dated July 10, 1899, has been received and is printed as a separate publication.

The report embodies the work of the commission in fairly testing the claim of Professor Sanarelli, of Bologna, Italy, that the bacillus icteroides is the cause of yellow fever, and the conclusion is drawn that this famous scientist has isolated the true cause of the terrible scourge.

This conclusion is based upon a careful bacteriologic study, in the well-equipped laboratory of the Marine-Hospital Service in Havana, Cuba, of 22 cases of disease thought to be yellow fever by the native physicians in attendance.

Of these cases all were seen during the progress of the disease, and in 14 of them the commission concurred in the diagnosis.

Each case was the subject of careful bacteriologic study, before and, if practicable, after death. This consisted in the abstraction of blood in sterile bulb-tubes from the ear tip under careful asepsis. This blood was then diluted in the bulbs with meat-peptone bouillon, and after an incubation of twenty-four hours the growth was transplanted to fresh tubes of bouillon, from which, after twenty-four hours, Petri plates were made in series. From these the organisms present in the blood were isolated in pure cultures and studied. After isolation each organism was subjected to the cultural examination on all media, by means of which those meeting the demands of Sanarelli for the organism he discovered were readily selected and their pathogenicity for animals established.

Of the 14 cases diagnosed as yellow fever, the commission isolated the organism of Sanarelli, the bacillus icteroides, from 13, and in the case in which this organism escaped the observation of the commission it was isolated by an independent observer for whom tube cultures had been taken at an autopsy conducted by the commission.

Thus the even percentage of isolations has been obtained in these 14 cases, all of which presented prominent symptoms of the disease. In the cases not thus diagnosed the organism of Sanarelli was not obtained.

From the living blood in 12 of the 14 cases, abstracted not earlier than the third day of the disease, the organism was isolated, and in the 2 others it was obtained post-mortem.

The commission, having preserved a number of cultures made at the isolation hospital in the city of New Orleans from cases seen during the epidemic of 1897, also isolated therefrom the bacillus icteroides in the proportion of 83.33 per cent of the cases examined, the cultures having been made at autopsy.

Thus the identity of the bacillus icteroides of our Southern States with that found in Cuba and that sent the commission by Professor Sanarelli, which was obtained in South America, was established.

As a control to these examinations the commission made use of a number of cases suffering from diseases other than yellow fever, from which the blood, extracted in the same manner and treated in the same way, failed to yield any organism at all comparable to Sanarelli's. These diseases were representative of those usual to the city of Havana, and were seen during the same period of time in which the cases of yellow fever were under observation.

Also there were 31 dead bodies examined, bodies dead from known and unknown diseases, many of them in the city morgue, the most of them in the Spanish military hospitals. In each instance careful section was made and the blood from the heart, from the liver, the spleen, and the kidneys, and the urine and feces, planted directly into bouillon or agar-agar slant tubes, from which cultures series of plates were made.

All bodies thus examined, at times many hours after death, yielded colonies of various organisms, save one, and this at the time of autopsy was diagnosed pathologically as yellow fever and was sterile.

In none of these cases of comparative autopsic examination was the bacillus icteroides found—neither in their blood, nor urine, nor feces. Therefore the commission assumes that the organism of Sanarelli is found only in bodies sick with or dead from the disease of yellow fever, at the same time conceding that in many of the sick the blood does not yield the germ, and that in the dead it may prove absent only under certain conditions.

Coincident with the above observations the commission carried on the study of the natural history of the organism as to its mode of entering the body, its colonization therein, its toxic possibilities, and its distribution in the organs post-mortem.

Numerous and interesting experiments were made with animals, the commission finding all the animals at its command, such as mice, rats, dogs, cats, guinea pigs, rabbits, and monkeys, quite susceptible to the artificial infections produced by inoculating them under the skin, intraperitoneally and endo-venously. At the same time it became convinced that the same or very similar results were obtainable by the use of other organisms of different kinds. It found, as had been claimed by Sternberg, that similar clinical and anatomical results could be found after the artificial administration of the bacillus X, as well as that of Havelburg, and of the bacillus coli communis, all of which proved, artificially exhibited, very pathogenic to all animals, and autopsies upon these revealed similar conditions of the organs. Moreover, the toxins elaborated *in vitro* by the above-named organisms, X, Havelburg, and coli communis, and icteroides, were precipitated, purified, and tested comparatively upon animals, with the result that the commission decided that the *mode of death* from these toxins, when injected into animals, *was the same in kind*, and that the toxins differed only in intensity, and that of these the bacillus icteroides produced the most potent.

From these facts the commission, early in its work, became convinced that the claim of Professor Sanarelli, of having discovered the germ of yellow fever, was not established by any evidence presented in his published works, and that it was not tenable so long as it could be claimed that the bacillus of Havelburg and the bacillus X of Sternberg produced the same pathological conditions when artificially inoculated, and the commission recognized the validity of this claim, in view of the facts given above, although it had for a long time recognized both of these organisms as belonging to the colon group.

At this stage of its work the solution of the problem seemed very remote, but before turning to some other and unknown cause of this disease it was determined to place experimental animals under *natural conditions of infection*, since it was recognized that all preceding experimental work was so artificial that it was impossible for the commission to judge of the pathogenic, or rather *specific*, merits of the three prominent organisms.

From this animal experimentation the commission proves the natural specificity of the organism of Sanarelli; the absolute innocuousness of the bacillus coli communis, of the bacillus X, and of the bacillus Havelburg to even the most susceptible of animals; and a marked degree of similarity in the reaction of these animals (mice) to the *acute infectious organisms*, such as bacillus typhosus and bacillus choleræ suis, when exhibited to them naturally. The Sanarelli organism is thus eliminated from the colon group and associated with the acute infectious organisms.

The commission recognized that Sanarelli's claim was *only* one of pathogenicity and not of *specificity;* that until such demonstration of specificity there could be no *valid* claim for his organism. This validity the commission believes to have established in the conclusion that the bacillus icteroides is "naturally infectious to animals, the degree varying with the species; that in some rodents local infection is most quickly followed by blood infection; and, while in rabbits and dogs there is no evidence of this subsequent invasion of the blood, monkeys react to the infection the same as man."

The commission has determined "that the infection takes place by way of the *respiratory tract*," and that the primary colonization in the lungs is responsible for the first evidences of absorptive intoxication, such as fever, pains, etc., characteristic of the disease. Also that this primary colonization in the lungs and its poison symptoms may constitute the *entire attack* of the disease in many instances, an attack so light, so ephemeral, that even the most expert diagnosticians may not differentiate them from other ephemera, or poorly marked attacks of allied diseases, as, for instance, the *dengue*.

Moreover, the conclusion has been reached that what is known in the literature of yellow fever as the "reactionary fever," the "secondary infection" (from germs normal to the body), and the "secondary paroxysm" is due to the passage of the infecting germ, the bacillus icteroides, from its primary colony in the lungs into the general circulation, thus producing a "secondary paroxysm" so familiar, clinically, in all marked cases, unless of the *siderante* type.

This "secondary paroxysm" is then a septicæmic one, and it depends not upon bacillus coli communis, or bacillus proteus, or upon the micrococci, but upon the further colonization of the specific organism in the blood, thus bearing out Faget's observation that the "*decline*" *of the fever*, the true "secondary paroxysm," is as *specific* as the "rise" or the primary attack.

The commission recognizes the coincident invasion of the blood by the organisms of the respiratory tract, among which are found colon and proteus, as of possible, it may be frequent, occurrence; or these may invade from the alimentary canal "during the last hours of life," when the mucosa becomes impaired from stasis and this invasion becomes possible, such mixed septicæmiæ being of most severe type and frequently fatal. The commission, therefore, differs entirely from Professor Sanarelli in his theory that the disease of yellow fever is primarily a septicæmia. Indeed, it can scarcely be a matter of surprise that Sanarelli formulated this opinion seeing that he always produced, with (as he thought) unimportant exceptions, artificial infections by internal inoculations, which perforce must have produced septicæmiæ. Those cases not open to such explanation, which he observed in man, he explained in a still more unsatisfactory way; in fact, by the assumption that the germ selected to hide away in the spleen in small numbers during the *whole course* of the disease only to suddenly come forth and produce a septicæmia at its termination.

The commission, therefore, concludes that the theory of Sanarelli in this regard is not sustained by the facts of these cases, and offers the above solution of probably the most widely and generally observed characteristic of yellow fever, the "secondary paroxysm" characterized by a septicæmia.

The theory formulated and expressed by Dr. Sternberg, United States Army, that the "germinal principle" in yellow fever was to be looked for in the alimentary tract, an opinion evidently dependent upon the well-known influence of the disease upon the organs adjacent and contributive to this tract and portions of the tract itself, as the duodenum, has been found untenable by the commission, since there is no record of anyone ever having isolated the specific germ from the canal save in the case of its presence there through some capillary hemorrhage into its lumen.

The influence of the various disinfecting agents upon the bacillus icteroides has been studied by the commission with an eye to the practical advantages to be derived from a better acquaintance with the organism, and it is found that the organism is readily influenced by the mechanical and chemical agents in ordinary use. Cold, however, is not a factor in this process, for the organism resists the most extensive refrigeration, and no reliance can be placed on this mode of disinfection. On the other hand, the organism is very susceptible to dehydration and can not withstand artificial drying for more than ten to twelve days, and it is very probable that its susceptibility to *frost* is due to the lessened humidity of the atmosphere at such seasons rather than to the degree of cold experienced. Sunlight is very fatal to this organism, and no doubt is more so if the organism has lost its vitality through evaporation of its fluids, as in a frosty atmosphere.

The resemblance between the bacillus icteroides, in its behavior on certain media, and the bacillus of hog cholera, has been brought to the attention of the commission, and it has deemed the observation that there is a possible similarity in the pathogenicity of the two organisms in the domestic hog of great importance, although its experience in the observation of the cultural similarities leads to the conclusion that they are culturally distinct, while the infection of the domestic hog, in its experience, is impossible by the method pursued of feeding bacillus icteroides to them. However, the question being of too much importance to be determined without full data, the commission placed under treatment a number of domestic hogs in an environment free from suspicion of the possibility of any contamination with the bacillus choleræ suis, with a view to deciding the question of the reaction of these animals to the bacillus icteroides, administered to them in pure cultures in their food. These experiments were conducted at the U. S. quarantine station at Delaware Breakwater, and therefrom it is deduced, first, that the domestic pig is incapable of infection from the bacillus icteroides when introduced through the intestinal or digestive tract; and second, that the bacillus icteroides, when fed to pigs, will not produce any of the lesions or intestinal symptoms of hog cholera.

CONCLUSIONS OF THE COMMISSION.

First. That the microorganism discovered by Prof. Guiseppe Sanarelli, of the University of Bologna, Italy, and by him named "bacillus icteroides," is the cause of yellow fever.

Second. That yellow fever is naturally infectious to certain animals, the degree varying with the species; that in some rodents local infection is very quickly followed by blood infection, and that, while in dogs and rabbits there is no evidence of this subsequent invasion of the blood, monkeys react to the infection the same as man.

Third. That infection takes place by way of the respiratory tract, the primary colonization in this tract giving rise to the earlier manifestations of the disease.

Fourth. That in many cases of the disease, probably a majority, the primary infection or colonization in the lungs is followed by a "secondary infection," or a secondary colonization of this organism in the blood of the patient. This secondary infection may be complicated by the coinstantaneous passage of other organisms into the blood, or this complication may arise during the last hours of life.

Fifth. There is no evidence to support the theory advanced by Professor Sanarelli that this disease is primarily septicæmia, inasmuch as cases do occur in which the bacillus icteroides can not be found in the blood or organs in which it might be deposited therefrom.

Sixth. That there exists no causal relationship between the bacillus X of Sternberg and this highly infectious disease; and that this bacillus X is frequently found in the intestinal content of normal animals and of man, as well as in the urine and the bronchial secretion.

Seventh. That, so far as your commission is aware, the bacillus icteroides has never been found in any body other than of one infected with yellow fever; and that whatever may be the cultural similarities between this and other microorganisms, it is characterized by a specificity which is distinctive.

Eighth. That the bacillus icteroides is very susceptible to the influences injurious to bacterial life, and that its ready control by the processes of disinfection, chemical and mechanical, is assured.

Ninth. That the bacillus icteroides produces *in vitro* as well as *in vita* a toxin of the most marked potency; and that, from our present knowledge, there exists a reasonable possibility of the ultimate production of an antiserum more potent than that of Professor Sanarelli.

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TREASURY DEPARTMENT.
U. S. Marine-Hospital Service.

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SHIPMENT OF MERCHANDISE FROM A TOWN INFECTED WITH YELLOW FEVER.

BY

SURGEON H. R. CARTER, U. S. M. H. S.

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1899.

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TREASURY DEPARTMENT,
Document No. 2125.
Marine-Hospital Service.

LETTER OF TRANSMITTAL.

Treasury Department,
Office of the Supervising Surgeon-General,
Marine-Hospital Service,
Washington, D. C., July 18, 1899.

The Secretary of the Treasury.

Sir: I transmit herewith a brief treatise, prepared at my request by Surg. H. R. Carter, upon the "Shipment of merchandise from a town infected with yellow fever."

The article is a valuable one, and is submitted in the belief that it will prove serviceable should another epidemic of yellow fever prevail in the United States. In that event, the classification of freight and its treatment as indicated herein, it is proposed to make a matter of regulation, and I therefore request that the report in full be printed.

I have the honor to remain, respectfully, yours,

Walter Wyman,
Surgeon-General Marine-Hospital Service.

Approved.
O. L. Spaulding,
Acting Secretary.

LETTER OF SUBMITTAL.

GIBARA, CUBA, *May 21, 1899.*

SURGEON-GENERAL U. S. MARINE-HOSPITAL SERVICE,
Washington, D. C.

SIR: I submit herewith a brief article on "Shipment of merchandise from a town infected with yellow fever."

You requested me to write something on this subject when I could find time, and waiting for a steamer here the opportunity occurred.

It is the same class of short articles as was published in the brochure "Yellow fever" by the Service last year, with which it and the paper on "Train inspection," published in the Annual Report for 1898, would be naturally grouped.

It is an elucidation of the present Interstate Quarantine Regulations of the Treasury Department, going more into detail than do these regulations, and, moreover, shows that the Service originated, formulated, and operated under "Freight regulations" practically the same as were subsequently adopted by the Atlanta and New Orleans conventions.

Very respectfully, yours,

H. R. CARTER,
Surgeon, United States Marine-Hospital Service.

MERCHANDISE FROM A TOWN INFECTED WITH YELLOW FEVER.

Prior to 1897, when a differentiation of freight into classes was made by the Marine-Hospital Service, it had been the custom in the South for towns quarantining against a town infected with yellow fever to prohibit the shipment of all merchandise from the quarantined town, regardless of the nature or extent of the infection in the latter.

There was no attempt made to determine what could be shipped from such towns with safety and what should be barred as liable to carry infection. All classes of freight and baggage were equally and absolutely prohibited.

It is not pretended that the classification of freight made in 1897 was the first as regards its disposition from a sanitary standpoint. The first was in the United States Quarantine Regulations of 1893, and under these a classification in detail, quite analogous to the one in 1897, was promulgated the same year by Passed Assistant Surgeon White, of this service, at Hamburg. This, however, was for cholera, and the division for yellow fever, of course, was on a different line.

CERTAIN CLASSES OF FREIGHT SHIPPED FROM NEW ORLEANS IN 1897.

In 1897 a differentiation of freight into classes which could and could not be shipped was made at New Orleans, La., and some commerce carried on from the infected town. This was extended later to Mobile and Memphis. In 1898, having the experience of the past year, this work was taken up at New Orleans on a considerable scale, and to a small extent at Baton Rouge and Alexandria. From the first place a very considerable amount of freight was shipped.

The work done on these lines in 1897 was mainly original. It seemed at the time and it seems even now to be imperfectly understood, and it may be that a classification of merchandise on the above lines and a short exposé of the principles on which the differentiation rests would be interesting.

The classification to be submitted is essentially the same as the "freight rules" agreed to at the Atlanta convention of 1898, and which indeed are the crystallization and development of service methods since

1893, and in the framing of which the writer took some part.[1] Explanation will be given when considered necessary.

GENERAL PRINCIPLES.

For a proper appreciation of the subject it is well to enunciate clearly in the beginning a principle underlying many quarantine procedures, without which this brochure may be misunderstood.

In deciding on the imposition of any quarantine measure a balance should be struck between the risk obviated by its adoption and the loss which the measure entails.

We must thus not only consider whether a measure obviates a risk, but whether it entails a loss, and the relation between the two. In measures of quarantine we do not ask for absolute safety.[2]

It is unattainable, and it will frequently happen that the measures necessary to obviate small risks entail a loss on the communities adopting them greater than the risks thus obviated justify. These restrictions are not in such cases to be imposed.

ILLUSTRATIONS FROM MARITIME QUARANTINE.

Illustrations from the maritime quarantine system will explain my meaning. This is selected because its problems are worked out, and we can and do make it so much more safe than land quarantine, and thus can afford to take more stringent precautions.

First. It is certain that fomites introduced during the winter into the United States may retain their infection, and, being carried South, produce yellow fever the next summer.

To prevent this risk of infection (no matter how small, it is a real risk) it would be necessary to disinfect all possible fomites on all vessels from generally infected ports entering any port of the United States, North or South, at all seasons of the year. No sanitarian, as far as I know, has proposed this, nor should it be done. The risk, while a real one, is small and utterly incommensurate with the loss to commerce entailed by such a measure. And even were this done, to give absolute safety from fomites it would require to be supplemented by perpetual inspection and disinfection along the Canadian and Mexican frontiers.

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[1] Extract from the annual report of the Surgeon-General of the United States Marine-Hospital Service, 1898:

"By request experienced officers of the Marine-Hospital Service were detailed to attend this convention, and I authorized them to present to the appropriate committee the regulations which had been prepared by a board of officers of the service called to revise the old regulations. The measures adopted by this convention, which met and adjourned the same day, were practically the same as the regulations prepared by this board."

[2] Surgeon White expresses this by the epigram, "Quarantine is a sieve, not a dam," and adds, most truly, "to attempt to make it a dam insures its breaking down entirely."

Second. It is known and admitted by the great majority of sanitarians that the maximum period of incubation of yellow fever is greater than five days. It is also a universally admitted principle that for absolute safety the time of detention in quarantine of persons susceptible to infection and exposed to it should cover the period of incubation of the disease dating from last possible exposure. Yet the above time, five days after disinfection, is the maximum imposed at any station, on the general run of "presumably infected" vessels, i. e., vessels from infected ports without sickness actually aboard. The contention is that on an extremely small proportion of such vessels does fever develop, and that in only a small proportion of cases does the incubation exceed five days, and that thus the risk obviated by requiring more than five days would be small and out of proportion to the loss which would be thus inflicted on commerce. For land quarantine and on vessels coming with yellow fever aboard, however, a larger period is, I think, universally required. This is illogical if we were looking for absolute safety, but is in accordance with the above principle, and to my mind is wise and right.

This principle explains many things otherwise incongruous and illogical in our maritime quarantine system. For example, the quarantine division into Northern and Southern ports, although it is not held to be impossible that some of the Northern ports may be capable of receiving the infection of yellow fever, if sufficiently introduced; and again, the concessions to the fruit trade from ports where yellow fever exists, and a number of others. In other words, all communities take, and are willing to take, a small risk for a sufficient benefit to their trade. This principle, then, is already recognized and is generally applied in the maritime quarantine system, the most perfect that we have. It is of like applicability to land quarantine.

EFFECT OF OVER STRINGENCY.

The statement then, that in our quarantine measures we should "take no risk whatever," is not in accordance with the practice of the best sanitarians. Also it is to be noted that overstringency of quarantine restriction, especially if continuing for a considerable time and involving much loss and hardship, are apt, certain rather, to involve more risk by the amount of illegitimate communication, "sanitary smuggling," caused by them. This matter has been so thoroughly brought to the notice of sanitarians, and, indeed, to that of the general public the past two years, that it is unnecessary to dwell on it. *The object of the sanitarian is to obtain the maximum safety to public health with the minimum loss commercially.*

RISK.

Health, however, must rank first, and only minimum risks may be taken, and in the classification to be presented it is believed that this is kept well in view, and that when in doubt the decision has always been thrown on the side of safety.

It is admitted that any communication with an infected town may involve some risk, from fault of regulation or even of administration, yet it is believed that freight shipped under the provisions to be laid down will scarcely be a factor in increasing the risk; that it is well within the limits of safety given by any quarantine.

POSTULATES.

The following postulates from a paper read at and accepted by the New Orleans convention of 1899 bear directly on the subject of this paper, and had best be grouped here, to avoid subsequent continual quotation.

POSTULATE I.

CONVEYANCE OF INFECTION IS GENERALLY BY PERSONS.

Yellow fever is usually conveyed from infected places by persons and personal effects, the latter already infected, and the former having the fever in the stage of incubation. The former is by far the most common medium of conveyance. This is borne out by all experience. (Chaille-Sternberg committee of experts, 1879; Toner et al.)

In at least four-fifths of the cases in which the origin of the infection of yellow fever in a town is definitely traced it is found to follow the occurrence of a case of that disease in one who has been exposed in another place.

There have been many cases of infection where it was stated that the refugee brought no baggage; there have been very many when there was no evidence on this point, but the refugee being almost always the first attacked, and soon after arrival (other cases showing usually after two weeks), is against the theory of fomites, to which others, as well as he, would have been quite frequently exposed.

It seems hardly necessary to seriously consider the allegation that the infection is thus carried by the clothing worn at the time the man was taken sick. Considering how very rarely it is carried by the clothing of physicians visiting infected places, and that in many instances the arrival in the place subsequently infected occurs several days after leaving the infected town and after many miles of passage through the open air, it is not within bounds of reason to accuse the clothing worn by those people. Ordinary wearing apparel worn through the sun and air for any considerable time is freed from the infection of yellow fever.

There are, however, not a few cases in which packed personal effects have been the agent of conveyance. Other things besides personal effects, such as articles of merchandise, may of course convey infection, but in point of fact seldom do, and the instances in which it has been reasonably ascribed to general freight, not household goods or baggage, are conspicuous by their rarity. The writer knows of but one.[1]

POSTULATE II.

FACTORS OF DANGER IN SHIPMENT OF MERCHANDISE.

Merchandise other than personal effects shipped from a place in which foci of infection of yellow fever exist is dangerous in proportion to a combination of three factors:

(1) It exposure to infection.

(2) Its ability to receive and convey it.

(3) The measures adopted to free it from infection if exposed to it.

Both of the first two factors must exist to render the merchandise dangerous in the first place, and even then it may be freed from danger by proper measures to free it from infection.

The first depends on: (*a*) The degree of infection in the place; (*b*) the place of storage and handling of the merchandise.

Until the infection of a city becomes general the risk of infection is confined to residences, and places contiguous to them, and in the business portion of a city is rare, the wholesale business houses being practically free from it. Reference is here had only to a city in which there is such a difference in residence and business portion. Goods from the wholesale district of such a town, unless the infection of the place be very general, are little apt to be exposed to infection. Should the infection become very general, the wholesale district may be invaded.

The second depends on the nature of the surface of the merchandise. Smooth, clean, dry, nonabsorbing surfaces will scarcely, even if exposed to infection, convey it.

The third, on the process of disinfection to which the merchandise has been subjected. This requires no explanation.[2]

CLASSIFICATION OF MERCHANDISE NOT THE SAME FOR ALL TOWNS.

Since one element in determining the restrictive measures of quarantine to be imposed is the loss which accrues from their adoption, we must consider the commercial relations between the infected town and the quarantining district—whether the town naturally supplies this district or any part of it, and whether its place in so doing can be taken, and at what loss by other towns and other questions of this nature. The merchandise desirable to ship will differ for all these factors, and it is obvious that no classification can apply, at the best, for all different towns.

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[1] There is some reason to believe that the fever at Havana was introduced by second-hand buckets and cans from New Orleans used in Havana for packing oysters. These were collected from residences, groceries in the residence part of the town, were in all states of cleanliness and uncleanliness, and were rather under the conditions of "household goods" than general freight.

[2] Proceedings New Orleans Convention, 1899, pars. 190 to 199.

The one given is adjudged to be generally suited to the distributing centers for an agricultural community, i. e., for the larger cities of the Gulf and South Atlantic States, and we believe gives the minimum of risk with the minimum of loss to the community.

ADVANTAGE OF "FREE LIST."

It is desirable in such a classification to avoid requiring disinfection for merchandise which does not need it, and the aim has been (as was the practice in 1897 and 1898) to pick out the large class which does not need disinfection ("free list") and to disinfect carefully or to prohibit the remainder. To require the disinfection of a large amount of merchandise, knowing that 90 per cent of it does not need it, will generally result in not taking the requisite pains with the 10 per cent which does and in which the danger lies.

ARTICLES OF MERCHANDISE REQUIRING MORE THAN SUPERFICIAL DISINFECTION SHOULD, AS A RULE, BE PROHIBITED.

Practically only superficial disinfection is undertaken. Articles of merchandise requiring more than this should, save in exceptional instances, be prohibited shipment. Not that they are not safe if disinfected, but that it is in general not commercially advisable.

GENERAL CONDITIONS.

1. Articles should not be shipped from dwellings, nor from places contiguous to dwellings, nor from any place believed to be infected.
2. All articles shall be new, clean, and dry.

The reason for these conditions are obvious: They insure a minimum chance of exposure to infection of things shipped without disinfection; at the same time they impose a minimum loss because of the shipments prohibited being relatively unimportant.

SPECIAL CONDITIONS OF INFECTION.

I.—WHEN FEVER EXISTS IN A SPORADIC FORM.

Merchandise under the above conditions can be shipped.

The chance of any merchandise, except goods from the few infected residences, conveying infection is nil, and there need be no bar on any kind of merchandise fulfilling the above conditions.

II.—WHEN FEVER IS MORE THAN SPORADIC, BUT NOT GENERAL.

Merchandise of the above character may be shipped from the wholesale district of a city, except such as from its liability to infection would be especially apt to conserve it, such as fruit, vegetables in open crates, straw, sawdust, excelsior, and similar articles used for packing.

These articles can be shipped only if they have been preserved from possible exposure to infection or have been disinfected.

There is still no reasonable risk in merchandise shipped under the above conditions.

REASONS FOR PROHIBITING PACKINGS.

The materials excepted against are of such a nature that they are more liable than other merchandise to be exposed to infection, and as they are, or may be, culture media, any exposure to infection, even a slight one, might well make them dangerous out of proportion to other articles of merchandise. It is judged, then, that the risk of passing these excepted articles is in excess of the loss from their exclusion. They are therefore excluded. The special precautions to avoid exposure are to use clean, newly received excelsior, etc., and breaking bulk only when it is to be used in the uninfected packing house.

CONTAMINATION BY INFECTED HANDS.

As long as the wholesale district is not infected, the risk from ordinary freight shipped therefrom is practically nil. The chance of contamination of the above classes by the hands of people who have been in infected houses while theoretically possible is not to be considered. Most microorganisms live but a short time on an exposed surface of the body, and ordinary freight is not a culture medium, and even if thus exposed would not preserve infection. The employees at quarantine stations do not disinfect their hands to take out the newly sterilized clothing, although they have just handled that to be disinfected and have done so for twenty years at all stations with no bad results.

As long, then, as the wholesale district is not infected there need be no bar to the shipment of any ordinary merchandise, new, clean, and dry, which has been only in this district and is not a culture medium. Even dry goods and woolen goods, from some reason held to be especially dangerous, may pass.

GOODS MADE UP IN A CITY.

It must be noted, however, that goods (clothings, etc.) made up in a city are frequently made up at residences and others are to certain extent household goods. They are, of course, barred shipment.

TO DETERMINE IF HOUSEHOLD DISTRICT IS INFECTED.

To determine just when any part of the wholesale district becomes infected is not always possible; still, as long as the infection is not general in the residence portion of the town, it is fair to assume that the wholesale district is free from infection in the sense of presenting little chance of infecting ordinary freight shipped therefrom.

If, in addition, a pretty close watch be kept on this district, which is generally easy, from the number of inspectors one is apt to have working in it, we can be reasonably sure when there is doubt of its cleanliness, *and when there is doubt it may no longer be counted clean.*

SURFACES NOT LIABLE TO CONVEY INFECTION.

In case there is question as to the wholesale district being free from infection we have a further, and can make a sufficiently safe, guard in confining, and should confine our shipments to such articles as from the nature of their surfaces are not liable to receive or retain infection or to such as have been disinfected. Thus, under ordinary conditions of infection, we would have—

CLASS I.—*Articles to be shipped without disinfection.*

(1) New and dry material, with smooth, nonabsorbing surfaces, shipped unpacked, such as articles of metal and smooth, varnished, or painted wood, leather, etc.; machinery, no part of which is textile.

In the original circular of September, 1897, new lumber and new bricks—both with rough surfaces—were included in this list, and there was no reason why they should not have been shipped; but their freedom from infection was due to the location of the brick and lumber yards in New Orleans, far from any residence—practically in the country, rather than to the nature of their surfaces; and hence they do not belong to the "free list" under this head.

(2) Original packages in clean and smooth wooden or metallic containers not broken or packed in an infected locality.

(3) Articles in such containers put up and handled exclusively in the wholesale district, which from their nature or mode of packing are incapable of carrying infection, such as roasted coffee, refined sugar, coal oil, creosote, acids, beans, peas, rice, salted meats, and articles of similar character.

The reason for this is, I think, obvious; the chance of surfaces of this nature receiving and retaining infection can scarcely be said to exist. Similarly nil is the chance for beans, pease, etc., with their smooth surfaces exposed for a few minutes from one container to another. For roasted coffee packed at 250° to 260° F., and refined sugar, also packed hot, there is no question they, like the antiseptics, are then germicidal.

Lime, cement, ice, salts, grain, and similar articles, when shipped in bulk, being incapable of receiving and conveying infection, together with beer packed in ice or in refrigerator cars, belong to the free list.

For coke, coal, gravel, etc., placed by the New Orleans schedule in the "free list," the safety depends on not having been exposed to infection. The last, if exposed or mixed with dirt and trash, as is usual, might well convey infection. It is no safer than ballast which is rejected at maritime quarantine.

THROUGH MERCHANDISE TRANSFERRED IN THE TOWN.

To the list that may go without disinfection must be added such merchandise as may be transferred through the town under such conditions that it is not exposed to infection.

First. Merchandise passing through in closed cars.

Second. Merchandise directly transferred from car to car at a clean siding, or from vessel to car, or vice versa, at a clean wharf. The point to preserve here is the "direct transfer," making a minimal exposure in event of there being some unknown infection at the siding or wharf.

We must on this account except such merchandise as is or may be a culture medium and would be exposed to infection if it existed at the place of transfer; thus cabbage in crates with large exposed surfaces, rotting leaves, stems, etc.; potatoes and other vegetables and fruits in bulk; oranges and lemons that have to be handled and sorted out on the platform are barred. In barrels the same merchandise could pass.

Bananas, although imported in bulk, make a direct transfer. They are taken directly from vessel to car without landing on the wharf. They have smooth surfaces, and for commercial reasons no soft bunches or bunches of whose firmness there is any question are shipped. They are allowed shipment.

It was required that the cars in which were loaded bananas, the only fruit shipped in bulk through New Orleans, be washed down with bichloride of mercury. This was done because some of the fruit is liable to decay en route, and should there be even the slightest infection in the car the decayed fruit might serve as a culture medium and make a focus of infection. The risk without it was minimal, but it was easy to do and was probably a wise precaution.

The rules, then, of the New Orleans convention cover these points very well.

(*a*) Fruits, sound, and taken directly in good condition from clean vessels or cars, which have complied with all quarantine requirements, and transferred at wharfs or railroad depots not infected and in good sanitary condition immediately to the disinfected cars or vessels for shipment.

(*b*) Fruits, vegetables, and Western produce in barrels or boxes directly transferred as above.

(*c*) Freight in good sanitary condition taken directly from clean vessels or cars to cars or vessels at a wharf or railroad siding not infected and in good sanitary condition.

New bricks, new lumber, etc., can nearly always be shipped on the "free list" because of the location of the yards where these things are stowed. They need no separate mention. Live stock, too, save for the litter with which they are accompanied, would not convey infection, although the wool of sheep might. They were refused shipment on this account in 1898.

CLASS II.—*Articles to be shipped with superficial disinfection.*

COMPLETE DISINFECTION NOT GENERALLY ADVISABLE.

Disinfected, of course any article can be shipped, but the conditions which are obtained in an infected town during an epidemic are such that it is not generally possible to undertake the disinfection of merchandise of which the interior may be infected. In exceptional cases, when it is extremely important to have the merchandise shipped, as for filter press cloths, etc., it can be done, and was done in 1897 and 1898, but it is generally impracticable, and should not be generally undertaken.

SUPERFICIAL DISINFECTION.

Fortunately we can differentiate a large class of goods in which the infection, if it exists, can be only superficial, and for which then a superficial disinfection is sufficient.

The following articles will require only superficial disinfection—i. e., outside of containers:

First. *All goods in original wooden or metallic packages, not broken or packed in an infected locality, when not included in Class I.*

These articles may not be included in Class I (*a*) on account of the nature of the surface of the container, it being rough, etc., or (*b*) because we are in more doubt as to its having been exposed to infection in such a way or extent that it may not convey it.

Second. *Articles which from their nature and mode of packing are incapable of receiving infection, and which sterilize the inside of the container, such as roasted coffee, refined sugar, molasses, coal oil, creosote, acids, and articles of a similar character, when not included in Class I.*

This is not the same as (3) Class I, because if the outside of the container requires disinfection, it is reasonable that the inside of it does also, and thus only such things as sterilize the inside of the container are advisable.

Third. *Original packages in textile material, not broken or packed in an infected locality and kept perfectly dry, except sacking, jute bagging, and textiles in loose covers.*

In the rules as originally issued, in September, 1897, this read, "Original packages in textile containers kept dry and clean require disinfection of the outside of the container only." In that at Atlanta, 1898, this was modified (by Dr. Harralson, of Mississippi, the writer, accepting and advocating the change) to "Original packages other than textile containers," etc. In the New Orleans conference of 1898 this reads, as it did at first with the explanation, "This includes coffee, grain, osnaburgs, and other cotton goods in solid bales with close coverings."

The trouble is a practical one, and the merchandise in question is the cotton and cotton bags of jute, of which an immense quantity passes through New Orleans.

If the textile container had certainly been kept dry and clean, unquestionably the gaseous disinfection properly applied would penetrate farther than any infection could; but there were two difficulties:

First. It was exceedingly difficult to be assured that the material in question (the bales of jute bagging) had been always kept clean and dry, and so little pains was taken with the storage that the presumption that this had been so was not sufficiently strong, and if it had been wet the infection might well be more than superficial.

Second. It was difficult to so dispose the bulky, yielding bales as to get all surfaces exposed to the disinfection. If, then, it had been presumably exposed to infection it was unsafe. Accordingly it was barred (in 1897). The other textiles, osnaburgs, are under different conditions, close bailed and of close texture, and for commercial reasons must be kept dry and clean. The bales are small and rigid and easily disinfected on all surfaces.

Both Atlanta and New Orleans intend to exclude the jute bagging, and it seems as well to do it in terms.

NOTE.—Any article, of course, can be shipped if entirely disinfected.

COMMERCIAL RELIEF AFFORDED BY THIS CLASSIFICATION.

An inspection of the classification will show that it allows without disinfection, or with practical—i. e., superficial—disinfection, a considerable proportion of the merchandise most needed in the agricultural districts of the South, i. e., wholesale groceries, machinery, agricultural implements, salt, oil, etc., and thus imposes the least possible loss on the section of country quarantining which can afford to wait for its "piece goods," etc., until frost. Indeed, except for the embargo on cotton bagging (jute), it would give such a district nearly all that it really needs during an epidemic in the city which usually supplies it.

It gives also a great relief to the city itself, but by no means so much as to the quarantining district. It is not possible to do this if the disease is fairly general—i. e., is epidemic—as full disinfection (not superficial) would be the only way to render many shipments safe, and that is, as I have said, inapplicable.

NOTE.—The New Orleans convention, referred to in the preceding article, was held February 9, 1899. The proceedings are published in pamphlet form. The Service was represented in this convention by Surg. J. H. White, who was appointed chairman of the committee on revision of the Atlanta regulations. Surgeon White, in his report, states:

"The one object sought by your representative was the obtaining of a formal agreement to report first cases, be they either suspicious or positive. This, as may be seen, was fully attained.

"The remaining resolutions are, I believe, in full accord with the regulations of the Marine-Hospital Service, and in many cases they parallel the quarantine regulations framed by the board convened in Washington one year ago."

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TREASURY DEPARTMENT.

U. S. Marine-Hospital Service.

REPORT

OF

COMMISSION OF MEDICAL OFFICERS

DETAILED BY AUTHORITY OF THE PRESIDENT
TO INVESTIGATE

THE CAUSE OF YELLOW FEVER.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

TREASURY DEPARTMENT,
Document No. 2128.
Marine-Hospital Service.

INTRODUCTORY.

LETTERS ADDRESSED TO THE SECRETARY OF THE TREASURY, RECOMMENDING AN INVESTIGATION BY OFFICERS OF THE MARINE-HOSPITAL SERVICE INTO THE CAUSE OF YELLOW FEVER, WITH SPECIAL REFERENCE TO THE REPORTED DISCOVERY OF THE YELLOW FEVER GERM BY PROFESSOR SANARELLI.

TREASURY DEPARTMENT,
OFFICE SUPERVISING SURGEON-GENERAL
MARINE-HOSPITAL SERVICE,
Washington, D. C., August 30, 1897.

The SECRETARY OF THE TREASURY.

SIR: I have the honor to invite your attention to the announcement of Dr. Guiseppe Sanarelli, of Montevideo, who alleges to have discovered the specific cause of yellow fever. The researches leading to this discovery were published first in full in the annals of the Pasteur Institute.

On carefully analyzing his results, especially his comparative experiments, one is bound to come to the conclusion that they are the researches bearing the stamp of a painstaking and conscientious observer.

It appears more than probable that Dr. Sanarelli has discovered the germ of yellow fever. The claims made by Sanarelli are of such a character that they are difficult to refute, even if there were a desire to do so, by reason of the fact that they are marked with thoroughness and clearness which admits but little question, and although some of the statements made with regard to the etiology and pathology and prophylaxis of yellow fever are in striking contrast with the present preconceived notions, they are not sufficient to invalidate his claims.

Should his alleged discovery prove to be true, it is one of the greatest boons which has been given to the world since Koch announced the cause of tuberculosis and of cholera, and may now make it possible to apply even more successful measures in the prevention and treatment of yellow fever than of other acutely contagious diseases.

The discovery is one of the most vital interest and importance to the United States. More than 20,000,000 of our population live in a section of country which possesses all the natural conditions for the disease to become epidemic if once introduced. To prevent this the Government is compelled to maintain large and numerous quarantine establishments for the purpose of guarding against its introduction, and entailing expenses and hardship upon our maritime commerce.

By this discovery it seems more than probable that many of the restrictions now imposed may be dispensed with, since it is possible to deal with a known entity.

With these possibilities in view it would seem advisable to send an expert to investigate and confirm the claims of Dr. Sanarelli in order that the advantages of this alleged discovery may be made available to the people.

I have therefore respectfully to recommend that an officer of the Marine-Hospital Service, P. A. Surg. H. D. Geddings, be detailed for this duty.

Dr. Geddings is now in Europe where, at the Pasteur Institute, he has been engaged in a special course of bacteriological research, and has already made a preliminary study of the germ discovered by Sanarelli. He is an expert bacteriologist, has had a large experience both in the observation and treatment of cases of yellow fever, has himself had the disease, and is eminently fitted for this duty.

It is suggested that Passed Assistant Surgeon Geddings be sent to Montevideo to study the germ under the direction of Sanarelli, and afterwards, should it be thought necessary, to visit the places where yellow fever is epidemic, viz, Santos and Rio Janeiro, where he can make confirmatory studies upon the cases, arrive at independent conclusions concerning it, and acquire a practical knowledge of the application of this great discovery.

The expense connected with this investigation would be small, being confined to the officer's actual expenses, and with the approval of the President could be paid from the fund for the prevention of epidemic diseases.

I have the honor to remain, very respectfully, yours,

WALTER WYMAN,
Supervising Surgeon-General, M. H. S.

Approved.
L. J. GAGE, *Secretary.*

TREASURY DEPARTMENT,
OFFICE SUPERVISING SURGEON-GENERAL,
MARINE-HOSPITAL SERVICE,
Washington, D. C., November 8, 1897.

The SECRETARY OF THE TREASURY.

SIR: I respectfully invite your attention to my letter of August 30, 1897, requesting authority to send Passed Assistant Surgeon Geddings to Montevideo to make investigations into the reported discovery of the germ of yellow fever by Dr. Sanarelli, and to subsequently pursue investigations into the cause of this disease at Santos, Rio de Janeiro, or other yellow-fever-infected ports. This letter was duly approved by yourself, and was prepared also for the approval of the President. The letter was not presented to the President immediately, as he was out of the city. In the meantime, within a few days, the present epidemic of yellow fever in the South was announced at Ocean Springs, Miss., and the detail of Dr. Geddings was held in abeyance, because his services were immediately required in the yellow-fever district. Later, while on duty in New Orleans, he was directed to pursue the investigations, taking advantage of the yellow-fever epidemic in that city. Passed Assistant Surgeon Wasdin, who made the first diagnosis of the yellow fever in the present epidemic, and who himself contracted the disease and recovered therefrom, was also detailed for like service. Dr. Geddings, in a report dated November 1, states that Dr. Wasdin and himself have carried their investigations to a point where it is desirable that they should be continued in some more favorable locality. Authority is therefore requested to detail these two officers for duty in the port of Havana, where yellow fever exists during the whole year, and where exceptional advantages may be had for the scientific investigation into the cause of the disease.

These two officers are especially qualified for this investigation.

P. A. Surg. Eugene Wasdin has made a special study of bacteriology, and was professor of pathology for four years in Charleston, S. C., in the Medical College of South Carolina.

As previously stated, he made the first diagnosis of yellow fever at Ocean Springs, and insisted thereon in the face of much opposition, and verified it by post-mortem examination.

Passed Assistant Surgeon Geddings is an expert in bacteriology and biological chemistry, and is attached to the hygienic laboratory of the Service. Several years ago he was ordered to Johns Hopkins Hospital, and the Bureau was given a written assurance by the director of the laboratory of his competency to conduct original investigations.

In later years he has been frequently called upon for special work of this character, his latest detail being as technical delegate on the part of the United States to the International Sanitary Conference held at Venice during the months of February and March, 1897.

After the adjournment of the Venice conference Dr. Geddings was engaged in special laboratory work in the Pasteur Institute in Paris and in Koch's laboratory in Berlin, paying special attention to the discoveries of Sanarelli, as stated in my letter of August 30.

The discovery of the cause of yellow fever is a matter of vital interest and importance to the United States, as it would result in obviating large expense, and place the preventive measures upon a strictly scientific basis, and prevent needless panic and such paralyzation of commerce and traffic as has prevailed during the past two months.

Furthermore, it may be possible not only to ameliorate the conditions affecting commerce, but in the near future to apply preventive and curative measures to the individual.

I, therefore, respectfully request approval of this detail, the expenses for which can legally and appropriately be paid from the epidemic fund.

Respectfully, yours,

WALTER WYMAN,
Supervising Surgeon-General M. H. S.

Approved.
L. J. GAGE, *Secretary.*

Approved.
WILLIAM MCKINLEY.

LETTER TRANSMITTING REPORT.

TREASURY DEPARTMENT,
OFFICE SUPERVISING SURGEON-GENERAL,
MARINE-HOSPITAL SERVICE,
Washington, D. C., July 26, 1899.

The SECRETARY OF THE TREASURY.

SIR: Referring to my letters of August 30 and November 8, 1897, I have to transmit herewith the report of the commission of medical officers of the Marine-Hospital Service detailed by your direction and that of the President to investigate the nature of yellow fever.

This work was begun by Surg. (then P. A. Surg.) Eugene Wasdin, in accordance with Bureau order of September 11, 1897. Dr. Wasdin, who had made the first diagnosis of yellow fever at Ocean Springs, Miss., and had himself contracted and recovered from the disease, was directed to make investigation into the cause of yellow fever as indicated by Sanarelli, and was furnished by the Bureau with a bacteriological outfit for this purpose.

On October 4 he was relieved from duty at Ocean Springs and ordered to New Orleans, where the opportunities for investigation were greater, and on the 6th of October P. A. Surg. H. D. Geddings was ordered from Jackson, Miss., to New Orleans for the same purpose. These two officers were directed to work together or independently, as might be agreed between them, and they conducted all the work conjointly. Notice of this investigation was published in Public Health Reports of October 8, 1897.

November 1 they reported they had carried their investigations to a point where it was desirable to continue them in some more favorable locality, and accordingly their formal detail for duty in the port of Havana was requested and approved by yourself and the President, mention of this detail being made in Public Health Reports of November 12, 1897.

December 1, 1897, the two officers arrived in Havana, obtained suitable rooms, established a laboratory, and continued their investigations until March, 1898, when, on account of threatened hostilities with Spain, they were returned to the United States and their services engaged in quarantine work during the ensuing summer and fall. In the meantime they submitted a preliminary report upon the work already accomplished, which was published in the Public Health Reports of November 11, 1898.

November 8, 1898, both officers were directed to return to Havana and resume the investigation, which had been suspended on account of the war with Spain. They continued their labors in the laboratory, which had remained undisturbed during the war, until June of the present year, when they informed the Bureau they had arrived at definite conclusions, and requested that they be ordered to Washington to prepare a report, which follows.

The findings of this commission, verifying the discovery made by Sanarelli, and making still further advances than did Sanarelli himself by determining the specificity of the bacillus icteroides, and that the primary infection of yellow fever is received through the respiratory tract, in other words, verifying one discovery and making others of almost equal importance, at the same time eliminating incorrect theories, must be considered a notable achievement in medical science and one of great practical value to the people of the United States and other countries infected or liable to be infected by yellow fever.

The findings of the commission, also, with regard to the susceptibility of the bacillus icteroides to germicidal influences, and the possibility of the production of an antitoxic serum which may operate as does the antitoxin in diphtheria, both to prevent and cure the disease, are matters of the greatest interest and importance. The preparation of the antitoxic serum by improved methods and with a hope of obtaining a serum of sufficient potency to be of practical value has already been begun in the hygienic laboratory of the service.

In view of the widespread interest which this report will excite and the practical deductions to be drawn therefrom, I have respectfully to request authority to have the same printed.

Respectfully, yours,

WALTER WYMAN,
Supervising Surgeon-General M. H. S.

Approved.

L. J. GAGE,
Secretary of the Treasury.

REPORT.

WASHINGTON, D. C., *July 10, 1899.*

SIR: In compliance with your order of the 11th of November, 1897, instructing us to proceed as a commission, appointed "by order of the President," for the purpose of investigating the cause of yellow fever to Havana, Cuba, and there to make all necessary arrangements for the prosecution of this investigation, we have the honor to report that your instructions have been fully and faithfully carried out, the investigation having been pursued until definite results were obtained, and we now ask to be allowed to submit these results, giving in detail an account of the technical work upon which our observations were based, and from which the following conclusions have been drawn:

CONCLUSIONS.

First. That the microorganism discovered by Prof. Guiseppe Sanarelli, of the University of Bologna, Italy, and by him named "bacillus icteroides," is the cause of yellow fever.

Second. That yellow fever is naturally infectious to certain animals, the degree varying with the species; that in some of the rodents local infection is very quickly followed by blood infection, and that, while in dogs and rabbits there is no evidence of this subsequent invasion of the blood, monkeys react to the infection the same as man.

Third. That infection takes place by way of the respiratory tract, the primary colonization in this tract giving rise to the earlier manifestations of the disease.

Fourth. That in many cases of the disease, probably a majority, the primary infection or colonization in the lungs is followed by a "secondary infection," or a secondary colonization of this organism in the blood of the patient. This secondary infection may be complicated by the coinstantaneous passage of other organisms into the blood, or this complication may arise during the last hours of life.

Fifth. There is no evidence to support the theory advanced by Professor Sanarelli that this disease is primarily a septicæmia, inasmuch as cases do occur in which the bacillus icteroides can not be found in the blood, or organs in which it might be deposited therefrom.

Sixth. That there exists no causal relationship between the bacillus "X" of Sternberg and this highly infectious disease; and that this bacillus, "X," is frequently found in the intestinal content of normal animals and of man, as well as in the urine and the bronchial secretion.

Seventh. That, so far as your commission is aware, the bacillus icteroides has never been found in any body other than of one infected with yellow fever; and that whatever may be the cultural similarities between this and other microorganisms, it is characterized by a specificity which is distinctive.

Eighth. That the bacillus icteroides is very susceptible to the influences injurious to bacterial life, and that its ready control by the processes of disinfection, chemical and mechanical, is assured.

Ninth. That the bacillus icteroides produces *in vitro* as well as *in vita* a toxin of the most marked potency; and that, from our present knowledge, there exists a reasonable possibility of the ultimate production of an antiserum more potent than that of Professor Sanarelli.

ACKNOWLEDGMENTS.

We are indebted to the State and War Departments of our Government for the permission obtained to pursue our investigations in the Spanish province of Cuba and to continue the same after occupation by the United States forces. We especially acknowledge the courtesy of Governor-General Blanco and Secretary-General Congosto of the Spanish province of Cuba, and of the gentlemen of the Spanish medical staff, from whom we at all times received valuable assistance.

To Major-General Brooke, U. S. A., commanding the military division of Cuba, and to his chief of medical staff, Col. R. M. O'Reilly, and to Surgeon-Majors Gorgas and Davis, of the Department of Havana, we owe acknowledgment for numerous courtesies and aid in the prosecution of our work. We are also indebted to Maj. Gen. Fitzhugh Lee, U. S. V., for invaluable assistance while serving as our consul-general to Cuba.

We also acknowledge gratefully the spirit of friendly interest always evinced toward us by the medical profession of the city of Havana, and the assistance proffered and given us. Especially do we remember the courtesies received from the Academy of Sciences of Havana and from the staff of the laboratory of the "Cronica Medica Quirurgica," and its distinguished chief, Dr. Santos Fernandez.

Our acknowledgments are also due to our esteemed friend, the distinguished scientist, Dr. Carlos Finlay, who placed us under many pleasant obligations, and to the medical staffs of the various city hospitals of Havana.

Finally, we would express our appreciation of the interest of the President and of the Secretary of the Treasury, as indicated by their ready assent to our detail, and of your own active sympathy and support.

We have the honor to remain, respectfully yours,

EUGENE WASDIN,
Surgeon, M. H. S.
H. D. GEDDINGS,
Passed Assistant Surgeon, M. H. S.

SURGEON-GENERAL MARINE-HOSPITAL SERVICE,
Washington, D. C.

THE CAUSE OF YELLOW FEVER.

Since the discovery of the pathogenicity of the vegetable micro-organisms, or bacteria, numberless propositions have been advanced in favor of this property in organisms found associated frequently with the acute infectious diseases, and since many of these claims were based upon insufficient data and merely served to obscure investigation, and to retard, there resulted from the hands of that master in bacteriology, Robert Koch, in 1881, a series of requirements or postulates, each of which must of necessity be fulfilled by one claiming specificity for a new organism in a given disease and which, but slightly altered, are generally acknowledged to-day. In order that an organism may maintain the claim of specificity Koch requires:

1. The organism must be present in the blood or tissues of men or animals sick with or recently dead with the disease.
2. The organism must be isolated, freed from all foreign bodies or substances, and be procured in pure culture.
3. This pure culture introduced into susceptible animals must produce the disease in question.
4. In the disease thus produced the organism must be found distributed as in the natural disease.

And to these may be added a fifth requirement, viz:

5. That the chemical products of the organism when introduced into the tissues must produce symptoms and effects (but not necessarily the lesions) of the disease.

Have all of these requirements been fulfilled in the case of every acute, specific, infectious, or contagious disease? The answer must be, in all fairness, no. A certain class of diseases, certainly specific, clearly communicable, have not as yet yielded to research any specific micro-organism, and by these diseases are meant the so-called eruptive fevers, as smallpox, chicken pox, measles, scarlet fever, and rötheln.

The claim of Sanarelli, being the most recent as well as the most scientific claim as to the cause of yellow fever, naturally has occupied our attention to the exclusion of all others, especially in view of the fact that in 1890[1] Sternberg effectually disproved all such prior claims. During the epidemic of yellow fever along the gulf littoral of Mississippi, and in New Orleans, La., in 1897, especial effort was put forth by ourselves[2] and other observers[3] to isolate, if possible, the Sanarelli organism.

The results of that work have already been placed before you.[2] Immediately upon our establishment in Havana it became our effort to control the work of Sanarelli by a repetition of his experiments as given in his "memoirs,"[4] as well as to continue the search for the organism in all cases of yellow fever open to our study, and to control these cases by a series of observations in cases of and in bodies dead from other known diseases.

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[1] Sternberg, report on yellow fever, 1890; Treasury Department, Document 1328, Marine-Hospital Service.

[2] Preliminary report of commission, November, 1898, Appendix B, C, and D. See also Public Health Reports, vol. xiii, Nos. 45, 46, and 47.

[3] Archinard, New York Medical Journal, January, 1899.

[4] Annales de l'Institute Pasteur, 1897, June and November.

In the fulfillment of the first postulate of Koch, Sanarelli made use of 13 cases, isolating the organism in 7, or in 54 per cent. In New Orleans, during the epidemic of 1897, we obtained cultures from a number of cases and isolated the bacillus icteroides in 83.33 per cent of the cases, all of the work, save that of collection, being done in our laboratory in Havana, Cuba.

Owing to the impracticability of obtaining a record of the cases from which we isolated the bacillus icteroides in New Orleans, La., we must ask that you accept the diagnosis made in these cases by those competent to do so without a relation of the cases themselves. For your information we give in detail the histories of cases studied in Havana, regretting the impossibility of obtaining at times records of temperature and pulse rate, since such records were not deemed essential, even in the Spanish military hospitals, and the civil institutions were badly demoralized.

Case No. 1.—Seen in the military hospital at Regla, January, 1898. Name, X. Y.; aged about 35 years; a native of Spain; residence in Cuba two years, in the country districts.

History of an acute chill occurring at night, followed by high temperature; much pain in back and head and muscles of limbs, nausea, and vomiting.

On the fifth day of the disease the status presented was as follows: Facies—dull and heavy appearance of face and eyes, the former suffused, latter are yellow and injected; skin of body congested and decidedly yellow; gums congested and bleed on touch; much epigastric tenderness; some nausea, and, on the preceding day, some "black vomit;" temperature, 38.50;[1] pulse, 75; urine albuminous. Blood taken from ear tip in bulbs, the bulbs sown in bouillon, and this plated. From these plates the organism was readily isolated in pure culture. This case was seen but the once, and finally recovered. Temperature record and notes were promised us but were never given.

The organisms associated with b. icteroides in this case were b. proteus vulgaris and b. coli communis.

Case No. 2.—Seen at the military hospital at Regla, February 24, 1898. Name, Pablo S. Ligura; age, 23 years; a native of Spain; four years' residence in Cuba; declares he has had yellow fever two years before.

There is a history of malarial cachexia, much prostration and some emaciation, an obscure attack of chill and rise of temperature at night, with following chills.

Status presens: There is facial congestion; eyes are clear; tongue broad and lightly coated; herpes labialis; slight delirium; no trace of albumen in urine; no headache, but lumbago and pain in limbs; temperature, 37.4; pulse, 90; much epistaxis.

Our diagnosis was malarial fever. Blood from this case gave only a skin contamination.

Case No. 3.—Seen in company with Dr. Jacobson at the Quinta de Dependientes. History and appearance indicated a malarial attack. There was recurring chilliness; an irregular fever; albuminuria, and nausea and vomiting. There was also an opinion that it was the fever "de borras." We were decidedly of the opinion that it was not yellow fever.

Blood taken and successively plated and replated, but the only organism encountered was b. coli com., possibly of contamination from skin.

Case No. 4.—Juan Yljarbe Arguiñano, aged about 30 years; seen at the military hospital of San Ambrosio, February 13, 1898.

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[1] The temperatures recorded in this report are in the centigrade scale.

History: Residence in Cuba two years; served in Spanish army in the rural districts; in Havana three months. Became sick on the 10th with chill, and intense backache, headache, and pains in the limbs; nausea was incessant.

Status on 13th: Face flushed a dark red; eyes dull and yellow; pupils dilated; tongue furred with red edges; gums bleeding; skin of chest deeply congested; pain over liver and epigastrium; pain in head and eyeballs and back; temperature, 38°; pulse, 72; urine highly albuminous; dark and offensive stools. Diagnosis of yellow fever concurred in.

Blood taken from the ear on the third day of the disease planted in bouillon and plated gave a number of colonies of bac. icteroides. This case ended in recovery.

Case No. 5.—Jose Canaldas Caldet, aged 28 years, a native of Spain, was seen at the military hospital of San Ambrosio February 13, 1898.

There is a history of two years' army service in Cuba; he became sick in hospital while convalescent from venereal disease; there was a sharp chill, headache and backache, nausea and vomiting on the 9th.

Status on the 13th: The face is dull and yellow; eyes are suffused and yellow; there are bloody sordes on the teeth, and dried blood about alae nasi; the odor is pronounced; skin of body yellow and congested; some petechiæ on trunk; urine contains 25 per cent of moist albumen; the stools are black; temperature, 37.8°; pulse, 60.

There was no bedside record, but the interné told our interpreter that this want of correlation between pulse and temperature had been noted for two days.

Blood taken from ear tip in bulbs on the fourth day of the disease; plates gave numerous colonies of bac. icteroides, associated with b. coli communis.

NOTE.—Of these 5 cases we agreed in the diagnosis of 3, No, 1 at Regla, and No. 4 and No. 5 at San Ambrosio, and in these 3 the Sanarelli organism was easily found. In the 2 others the most diligent search failed to find the organism in the blood.

Case No. 6.—The case of Doane; aged about 50; a native of the United States.

History: Arrived in Havana on December 27, 1898, and was in service at the custom-house; was taken sick January 5, in the evening, with chill and intense head and back pains; nausea and retching; temperature rose to 39.8° C. (Dr. Castellanos) on the 9th; pulse low; always much epigastric tenderness; diagnosis of yellow fever.

Status on the 12th: The face is flushed from stasis; the eyes injected; conjunctivæ a bright yellow; skin of scalp (gray hair) a canary yellow; gums swollen and easily bleed; the tongue is read at tip and edges; the sordes are bloody; the skin of trunk a dusky yellow; urine contains 75 per cent of moist albumen; there is almost an anuria; the stools are tarry and offensive. He died at 10 p. m. of the 12th.

We drew blood from the ear tip in Sternberg bulbs (seventh day of disease), and succeeded in isolating the bac. icteroides in pure culture.

Case No. 7.—Private Patrick Smith, Eighth Infantry, United States Army; aged about 28 years; was seen in regimental hospital at the "Punta," a notably bad locality in Havana.

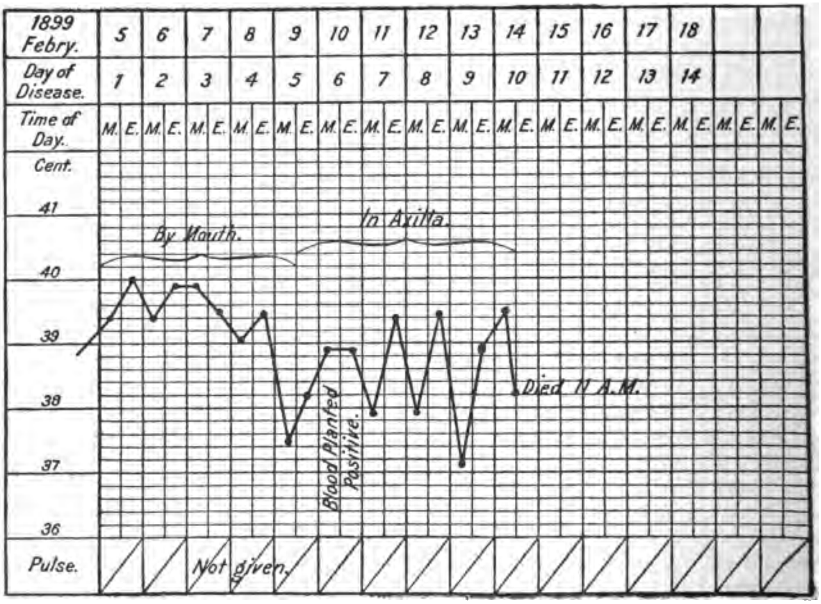
There is a history of malarial intoxication at Santiago during the Shafter campaign, and he had been under treatment for it recently. The present attack of illness came on on the 5th of February, 1899.

Status presented on the 10th: The face was pale and slightly congested; eyes slightly yellow, pupils dilated; gums pale but puffy; there was no tenderness, save on deep pressure, over stomach and liver; the urine was albuminous; the attendant stated that the stools were yellow and not black; the skin of body was tinted yellow; there was marked subsultus and an incipient delirium; temperature, 39°; pulse, 82.

When invited to give our opinion of the case, we gave a diagnosis of yellow fever of a serious type, and prognosed death within forty-eight hours. At this visit blood was taken from the ear tip (on the sixth day of the disease), and when plated gave us numerous colonies of b. icteroides; also of two other organisms, one a colon. We offered this organism in evidence as diagnostic on the 12th. Death ensued on the 14th at 11 a. m.

Necropsy three hours later, conducted by an acting assistant surgeon, United States Army: Rigor mortis marked; body yellowish, with considerable hypostasis in dependent portions of trunk; eyes tinted yellow; gums pale; section showed dry tissues; vessels of mesentery much engorged; liver congested, mottled yellow; gall bladder contained some bile; spleen was immense and firm to the touch, and, on incision, the result of preceding malaria; kidneys swollen, capsules nonadherent. Heart: Left contracted, right full of fluid blood. Stomach: External vessels engorged, mucosa swollen and eroded at points, submucosa ecchymotic and stained posteriorly and along the greater curvature; no free hemorrhage; no black vomit. The duodenum was intensely injected; the submucosa deeply stained from extravasations; no free hemorrhage. The entire small intestine was in this state of ecchymotic extravasation and stained submucosa; but at not one point was there an appearance of glandular enlargement, either solitary or agminate. In the neighborhood of the valve the congestion was less than in the higher portions of the organ. At the ileo-cæcal valve, in the mesentery, there were one or two mesenteric glands slightly enlarged. The appendix was not examined. The question of free hemorrhage along this long stretch of congestion was, in our opinion, undetermined. Cultures from all fluids and organs. In twenty-four hours the spleen gave a pure culture of b. icteroides, and the blood a culture but slightly contaminated. Other organs and fluids the same. There was observed no bac. typhosus.

[Case No. 7.—Patrick W. Smith; age, 28 years; disease, yellow fever.]



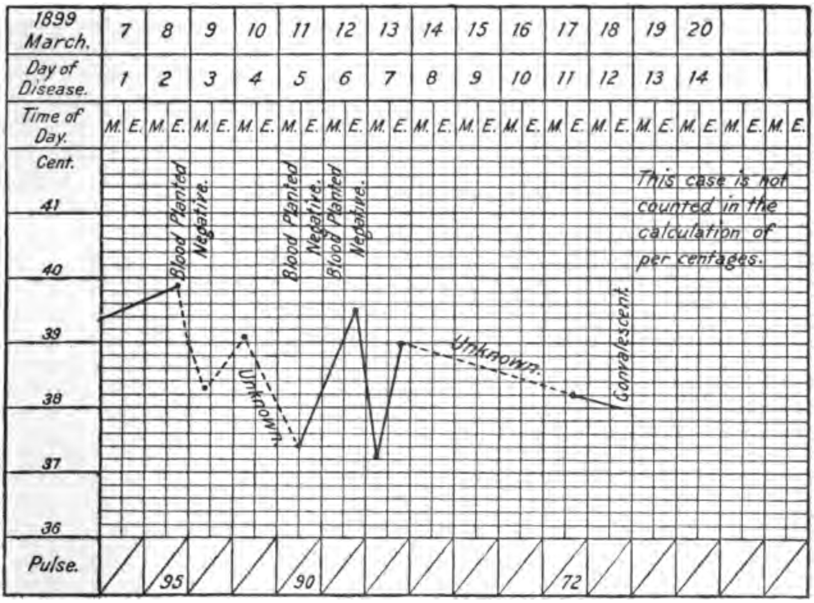
This case was a typical one of extensive invasion of the blood by the organism, a veritable septicæmia, however it started. It resembled closely in this respect the eighth case of Dr. Sanarelli, in which the bacillus icteroides existed in almost pure culture.

On the 12th, from the blood taken, a serum test was made in the dilution of 1 to 20, with a bouillon culture of b. icteroides, and there was not the slightest influence of either motion or of agglutination in three hours. Nor could we get a reaction at any time. This organism we have used very extensively in further work on animals, the resulting necropsies always showing the most characteristic changes in the liver, stomach, and intestines.

Case No. 8.—Michael Launigan; aged 30 years; a native of the United States; was seen at the Hospital de Nuestra Señora de las Mercedes.

There was a history of nonimmunism; of laboring on the Havana docks, last at the pier San José (a badly infected locality); he became sick on March 7, 1899, a. m., with chill, headache and backache, nausea and vomiting; not much muscular pain. The chill, he says, was followed by fever and "a sweat." Admitted to hospital on 8th. The urine was albuminous; the bowel constipated. He was seen by us on the 11th, 9 a. m.

[Case No. 8.—Michael Lannigan; age, 30 years; disease, yellow fever.]



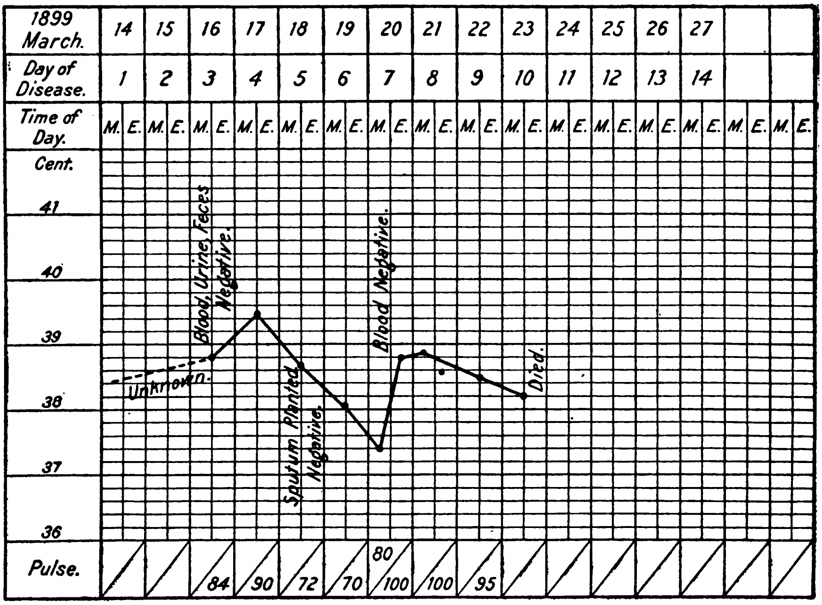
Status presens: Face dull, with slight passive congestion; eyes yellowish, with dilated capillaries; tongue furred; gums are swollen and retracted from teeth, bleeding on slight pressure; the skin of chest congested upon hand pressure; some pain over epigastrium; spleen normal; urine contains 25 per cent of moist albumen; the stools (one) black and very offensive; no black vomit; temperature, 37.4°; pulse, 90. Took blood from ear tip (fourth day of disease). On the 12th we were informed by telephone that this man was again very ill; a temperature of 39.5°; the albumen increased, as also the nausea and vomiting. Again seen by us, and we again took blood from the ear tip (fifth day of disease), and also samples of the stools and urine. From none of these was the bac. icteroides isolated. From the stool, urine, and blood we isolated that form of b. coli com., called by Sternberg "X" and by Archinard "A and B." On the 13th the man again had an accession of fever to 39° C. Pulse, 100. Quinine administered. This hospital is situated so far from our laboratory that attempts to examine fresh blood were futile. No malarial parasites in stained preparations.

The man again seen on the 17th, was very debilitated, and showed anæmic hallucinations; temperature, 38.3; pulse, 72; marked icterus; urine still albuminous; herpes labialis. Blood taken in bulbs, also urine and fæces, from which cultures were made. No organism save the "X" and a proteus. That this may have been yellow fever at first and afterwards had developed also malaria is most probable, but it remains in doubt. When we first saw him the facies and other symptoms pointed to yellow fever, for at this visit the temperature record was 37.4°., the *first* intermission. After this there were daily intermissions. From the extreme anæmia and debility convalescence was very tardy.

Case No. 9.—Manuel Corujo, a native of Spain; aged 20 years; resident in Havana two months, at Casa Blanca, where he was taken ill on the 14th of March at night, with headache, pain in back and limbs, nausea and vomiting. Entered Hospital de Mercedes on the 16th, with much pain in back and head; the urine slightly albuminous; temperature 39.5; pulse, 75.

On the 18th we saw him for the first time. The skin was icteroid and congested; urine contained 25 per cent of moist albumen. Blood, fæces, and urine taken and planted. On the 19th the albumen was 10 per cent; the skin icteroid; conjunctivæ icteroid; eyes injected; skin still very congested. On the 20th, a. m., blood again taken and planted. On 21st he was semidelirious, there was subsultus tendinum; the albumen was 18 per cent. On 22d in stupor; almost an anuria. On the 23d at midday he died, comatose.

[Case No. 9.—Manuel Corujo; age, 20 years; disease, yellow fever.]



Necropsy (*two hours post-mortem*).—Body of young adult male; no distinctive marks; rigidity present; skin of body yellow in tint; eyes yellow, pupils dilated; hypostasis of buttocks and loins. Section showed the tissues dry; mesenteric vessels engorged; peritoneal fluid yellow; liver a lemon-yellow, from fatty change; gall bladder distended by a large clot of blood (hematocele); spleen normal in size, dark slate color; kidneys congested, and when incised gave marked fatty areas about the bases of the pyramids of Malpighii; the diaphragmatic pleurae ecchymotic; pericardium ecchymotic; pericardial fluid distinctly yellow; the right heart full of dark blood; left ventricle contracted; the vasa vasorum of the great vessels beautifully distended; stomach contained 500 c. c. "black vomit;" mucosa eroded, stained, and ecchymotic; duodenum the same; bladder contained but little urine, highly albuminous; cultures from all sources; the bac. icteroides was isolated from the blood, but could not be found in the urine nor feces; it was present also in the spleen. From the urine and feces the bac. "X" was readily isolated.

Changes in the liver were as follows: Moist liver, 10 grams; dried liver, 3.22 grams; residue, 1.6 grams; fat, 1.62 grams, or 16.2 per cent of fat in fresh liver and 50 per cent of fat in dried liver.

Case No. 10.—Adolfo Montero; aged 27 years; a native of Spain; residence in Cuba just seventeen days, at "la Casa Blanca." Was taken sick March 19, in the evening, and when admitted to Mercedes Hospital he stated that he had been sick two days from headache and fever.

On the 22d we saw him. Blood was taken from the ear tip and planted. Temperature, 36.8°; pulse, 68; much nausea and vomiting; stomach tender to pressure; spleen normal; liver tender; gums swollen and congested; tongue with red edges; urine dark (hemoglobin), and contained 75 per cent of moist albumen. There was no daily record of temperatures in this ward of the hospital, and all that we could learn was that the temperature had ranged *high* with a *low* pulse rate, although the man disclaims any fever and affects to be much better than he really is. He is a fisherman, and states that a deeply congested and eruptive state of the face, neck, and arms was due to the sun. Diagnosis, yellow fever.

On 23d, temperature, 37°; pulse, 82 and good. He desires food; urine less albuminous and clear; eyes yellow and skin tinted. The bac. icteroides was found in this blood in abundance, together with a variety of b. coli com. Urine gave an "X" bacillus. Convalescence was very slow in this case, the eyes deepening in tint, as also the skin.

Case No. 11.—Captain Williams; British ship *North Anglia;* aged about 35 years; a native of England; was taken sick at 7 p. m. March 5, 1899.

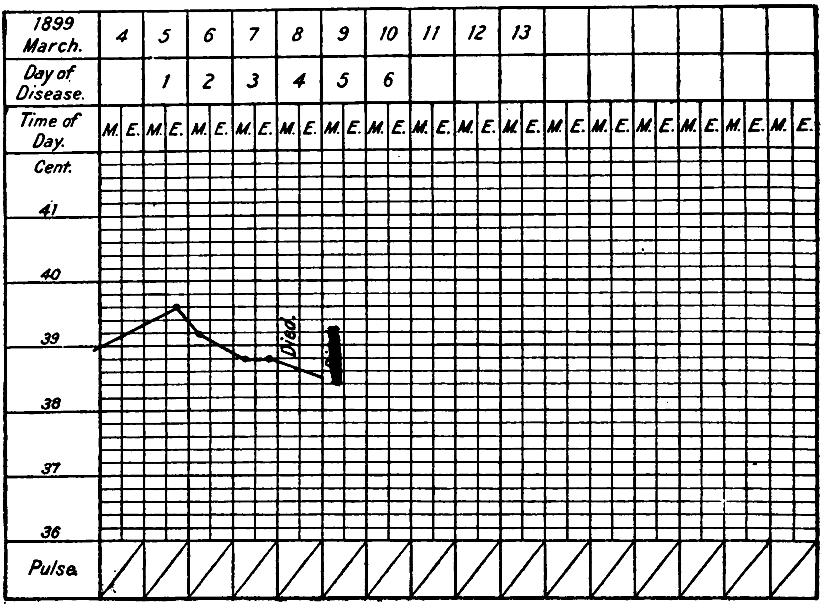
His physician informed us that there had been pain in head and back, with chill and fever to 39.6°.; the pulse not notably low.

On 6th, temperature 39.2°, nausea and vomiting; on 7th, temperature 38.8°; nausea and vomiting; great congestion of skin of face and neck; vomited dark-looking material. Died at 12 midnight of the 7th; ill just fifty-three hours.

There was no suspicion of yellow fever in this case until the morning of the 8th, when the steward of the ship was reported "very sick." We were notified and held necropsy on the captain at 2 p. m., 8th.

Necropsy.—Body of well-formed adult male; rigidity present and extensive stasis of face, neck, and trunk; eyes, yellow; pupils, dilated; skin, yellow; tissues, dry on section; vessels of the mesentery, dilated; peritoneal fluid yellow; intestines, dry on surface and sticky; *odor* *intense;* liver, a fine boxwood color from fatty change; gall bladder contains some 20 c. c. bile; spleen, normal in size, slate-colored; kidneys congested and show, on section, fatty change at the bases of the pyramids. Left heart contracted, right dilated with fluid blood; vasa vasorum of great vessels dilated; stomach contains 500 c. c. black vomit; mucosa ecchymotic; submucosa is stained a deep port-wine color and there is extravasation; the duodenum presents the same appearance; bladder contains a little urine, highly albuminous; lungs not carefully examined; ecchymoses and an infarct noted. Cultures from heart blood, liver, spleen, kidneys, peritoneal, and pericardial fluids, urine, feces, and gall bladder, and contents of stomach.

[Case No. 11.—Captain Williams; age, 35 years; disease, yellow fever.]



This was thought to be a case par excellence for bacteriologic investigation, but we were much disappointed. From the blood tubes taken we (Dr. Geddings) found *one colony* of b. icteroides in a plate from a bouillon tube, the spleen and liver gave a contamination of colon; the fluids and bile were sterile. The black vomit gave a beautiful bacillus "X," presenting the peculiarity, that Sternberg found, of marked motility when *first* isolated, but of *quickly* losing this *permanently*, not even its passage through animals restoring it. Later, through a large rat, to which we fed one of these "X" cultures, which we suspected of containing b. icteroides we (Dr. Wasdin) obtained b. icteroides from its *trachea.*[1]

Case No. 12.—Everette, steward on the *North Anglia;* about 35 years of age; English; was taken sick the morning of the 7th of April with chill and pains in the back and head and limbs; nausea and vomiting. On the 8th, at 2 p. m., we saw him.

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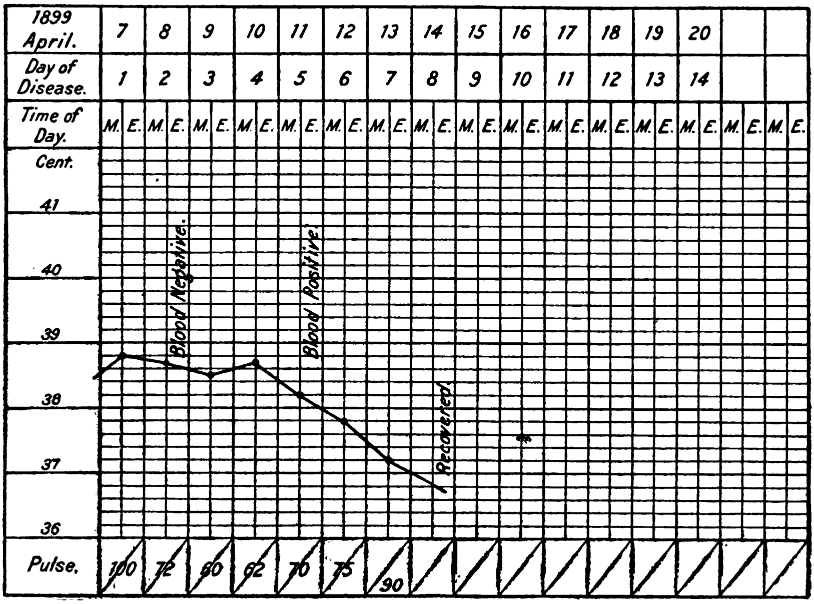
[1] This rat was caged in the closest proximity to several cages in which mice were being exposed to bac. icteroides, and since there is possibility of this rat having caught the infection from these cages, we have not used the result of the isolation of the bacillus in any percentage calculations.—(Wasdin.)

Status presens: The face is suffused, with some swelling about eyes and lips; conjunctivæ injected and yellow; eyes smoky; gums bleed on slight pressure; skin generally congested and yellow; urine scant and contains 25 per cent of moist albumen; we collected blood from the ear tip, in Sternberg bulbs.

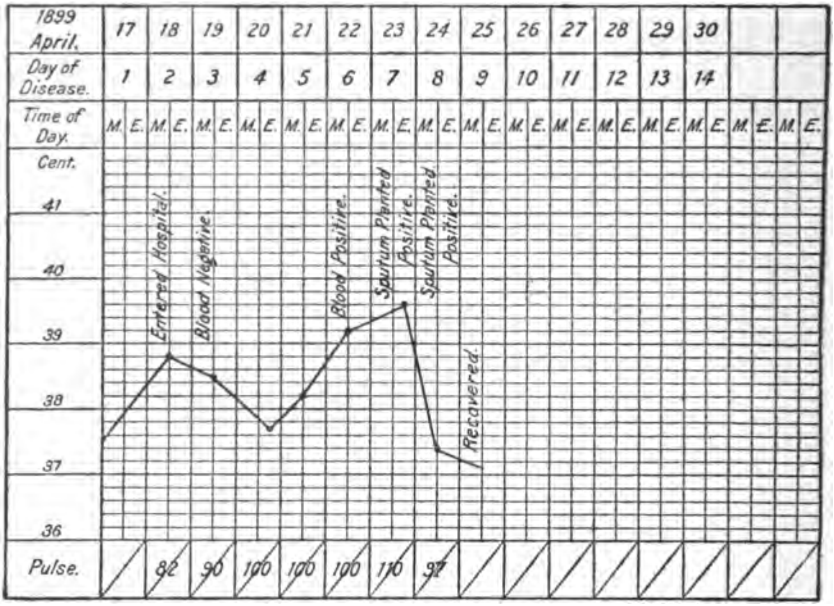
[Case No. 12.—Everette; age, 35 years; disease, yellow fever.]



On the 10th there was bloody expectoration with mucous râles in both subscapular areas, and some evidence of a lobular pneumonia. On the 11th again took blood and planted it; urine, 1.014, alkaline, with 25 per cent moist albumen. On the 12th he still expectorated bloody mucus. On the 13th he entered upon a tardy convalescence. A feature of this case were the lung symptoms, which gave rise to some alarm. His physician states that a bubbling fine râle was present when he first saw him, and that the bloody mucus was very free for several days. The blood serum of this man, diluted 1–20 and 1–10, gave absolutely no reaction in one hour with b. icteroides (G.). The bacillus icteroides was isolated from his blood taken on the 11th, but not from that on the 8th. A consultation of several physicians pronounced it yellow fever.

Case No. 13.—Kauna Sesein; aged 24 years; a native of Turkey; a resident of Havana two months. Seen at Hospital de los Angeles, April 19, 1899.

[Case No. 13.—Kauna Sesein; age, 24 years; disease, yellow fever.]



History.—She was taken sick on the morning of the 17th of April; no chill, but high fever; pain in head and back and limbs; great nausea and tenderness of epigastrium. When admitted, on the 18th, urine contained 20 per cent of moist albumen. On 19th she was seen by us, and blood taken and planted; the gums and skin were swollen and congested still; urine albuminous. We again took blood on the 22d. On 23d and 24th we obtained sputum, which was planted. This case was poorly pronounced, yet the blood taken on the fourth day gave colonies of the b. icteroides; also from the sputum there was obtained the bac. icteroides in pure culture.

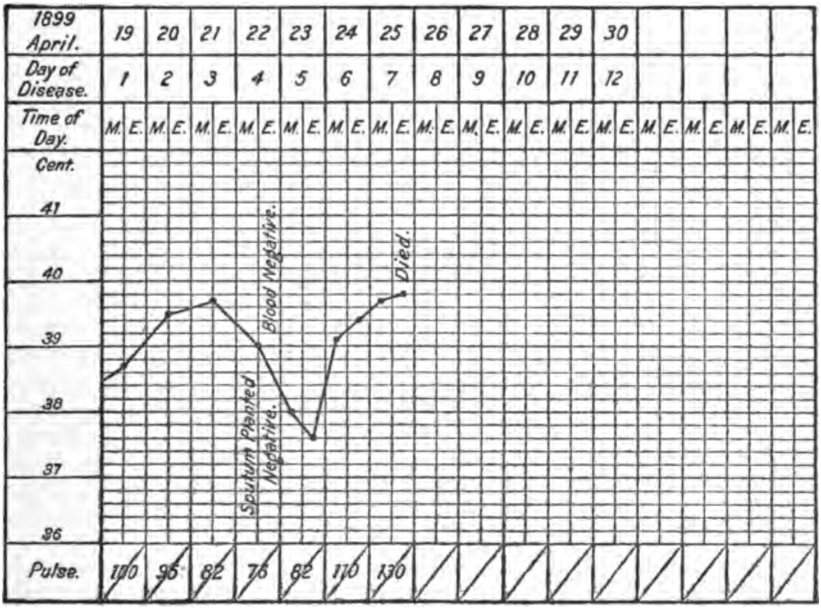
Case No. 14.—Pedro Quintela Macias; aged 30; from Spain; came to Cuba on January 29, 1899; residence at "la Casa Blanca," a notably infected village. Diagnosis of yellow fever.

No preceding illness. He was taken sick on Tuesday, 18th, at night, with a chill and high fever; severe pains in head and back and limbs; severe pain in the stomach with nausea, but no vomiting. He was admitted to "Hospital de los Angeles" on the 19th of April, 1899. On 22d he was seen by us. He then presented a congested face; pupils partially dilated; conjunctivæ yellow; vessels dilated; skin of body decidedly icteroid; some diarrhea; scanty urine, contained 25 per cent of moist albumen; specific gravity, 1.013; blood taken from ear tip and planted. There was some bronchitis; the sputum was distinctly blood-tinged and purulent. This was taken, and also the blood, and planted. On April 25 he died at 4 p. m.

Necropsy (two hours later).—Body of well-developed male adult; no distinguishing marks; rigor fairly established; skin yellow, with much hypostasis; eyes yellow and pupils dilated. On section the tissues appear dry; the vessels of the mesentery engorged; the contents of the abdomen of a rich yellow color; the liver of a deep yellow color, with congestive mottlings; the spleen slightly enlarged, quite firm; kidneys congested; bladder empty; gall bladder full of green bile (had not vomited much); the left heart firmly contracted; right distended with fluid blood; the vasa vasorum of the great vessels distended; pericardium ecchymotic on visceral layer; pericardial fluid yellow; the stomach and intestine hemorrhagic; the *lungs* especially studied; the trachea contained bloody sputum, its mucosa was injected; the bronchi were also full of stained mucus of a purulent character, their mucosa ecchymotic and swollen; the bronchioles were full of frothy, stained, purulent mucus. The right lung gave most change; the visceral pleura was distended at many points on the lower lobes with emphysematous dilations of the superficial air cells; it was ecchymotic, some extravasations being as large as the finger nail. On incision there was evidence of emphysema from the obstruction in the tubules; the vessels were engorged and the catarrhal secretion free, but not to the extent of a catarrhal pneumonia, the lung floating high in the water bath. We were forcibly reminded of the lung in "la grippe," but there was not that peculiar loss of elasticity of the lung framework which we have found in cases which have died from "grippe." The left lung presented the same picture, only less pronounced. The pleuræ were ecchymotic in both layers; the pleural fluid yellow. Cultures were made from all specific organs and fluids, from which the b. icteroides was *not* isolated. From the sputum we isolated the bac. "X," very motile, and the bacillus of sputum septicæmia.

From this case, we are informed by Surgeon-Major Meacham, U. S. V., that the bac. icteroides was isolated by him from the blood of the lung.

[Case No. 14.—Pedro Quintela Macias; age, 30 years; disease, yellow fever.]



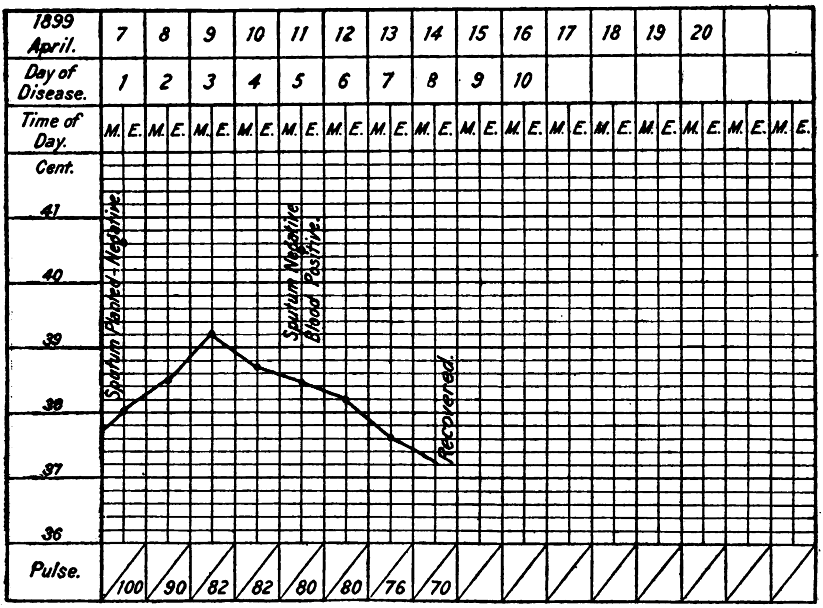
Case No. 15.—An unknown man, evidently of Spanish origin, and aged about 40 years; was seen at Los Angeles Hospital on the 10th of March, 1899.

There was no history whatever. He was unconscious when admitted from la Casa Blanca. When seen the man was moribund; unconscious; pupils dilated; face flushed; dry, bloody sordes about the teeth; tongue dry; breath fetid; gums swollen; skin icteric; urine scant and voided in bed; pain on pressure over liver and stomach evidenced by facial expression; delirium of low type; blood taken from ear tip and planted. Though clinical evidences in the case were not complete, nevertheless we made the diagnosis of yellow fever. The blood was taken and planted in bouillon, and from this plated, when it gave numerous and typical colonies of b. icteroides. Death ensued at 10 p. m. of the 10th. No necropsy was made.

Case No. 16.—Joachim Rodriguez; 19 years of age; one and a half months from Spain; in perfectly good health until May 7; residence on Aguacate street, a bad locality in Havana. During his stay in the city he has been employed upon the repairs and cleaning of the city sewers.

On the 7th of May he was taken sick with violent pains in his head and back. He stated on entry to the Los Angeles Hospital that he had had "*no* chill nor fever." He presented a flushed face; yellowness of the conjunctivæ; some pain in epigastrium; no nausea nor vomiting; temperature, 38°. There was bronchitis, and bloody sputum which was planted; the urine was albuminous. On the 11th the sputum was less bloody; again taken and planted. On the 13th there was convalescence. The blood was taken on 11th, and from it the organism isolated; b. ictoroides. But the sputum did not give it.

[Case No. 16.—Joachim Rodriguez; age, 19 years; disease, yellow fever.]



Case No. 17.—B. H. Powell; aged 30 years; American; recently arrived in Cuba; fell ill on the night of March 19 in the house adjoining the one in which Doane had died.

He gave a history to Dr. Menocal, who saw him for us, of headache and pain in left hypochondrium and abdomen. There was no icterus; no change in gums; no congestion of face nor skin of chest; no vomiting, and little nausea; there was but little fever; the temperature, 37.9°; pulse, 84; only a trace of albumen in the urine. Dr. Menocal did not concur in the diagnosis of yellow fever of the attending Cuban physician. No further information could be obtained. The blood taken on the 21st of March gave no organism of any interest. No sputum was obtained.

Case No. 18.—Gomez Garcia; aged 25 years; a Spaniard living at Casa Blanca, was admitted to the Hospital de Los Angeles at 8 p. m. of the 14th of March, 1899, quite ill and unconscious.

No antecedent history. We saw him on the 15th.

Status presens: He was semiconscious, dull, and stupid; defecation and urination uncontrolled; clothing was stained a brilliant saffron hue; it also showed signs of vomiting in dark green stains, with "fly-wing" threads; urine could not be gathered; skin cold; temperature, 36.8°; pulse, 120; eyes a little yellow; gums swollen and blue; tongue broad and furred and indented. Altogether it was thought to be a case of malarial intoxication, which differed from the diagnosis of the attendant of "yellow fever." Blood drawn from ear tip clots quickly in the bulbs; the serum showing a straw color; there was only a slight reaction of Widal, in 1–40, in half an hour.

On the 16th the attending physician voluntarily called at our laboratory to report that he had found the case to be "*not* one of yellow fever." The sputum was not obtained; the blood gave no organism of any interest.

Case No. 19.—Private Perkins, of the 202d New York Volunteers, stationed at Guanajay, Cuba, was seen by us on the 11th of February, 1899, in regimental hospital, the surgeon being absent.

There was the history of a twelve (preceding) days' illness and of some light malarial attacks during January; also of exposure to the unclean places in the seacoast town of Mariel and of exposure to the sun. He presented a bright, alert facies; a fine twitching of the muscles about the mouth, and other signs of subsultus; tongue furred and red-bordered; gums normal; no great nausea nor vomiting, only a little greenish fluid; no skin congestion; some pain in region of ileocaecal valve; urine held a trace of albumen for several days; there were no rose spots; no epistaxis, and but little inclination for food. Blood taken in Sternberg bulbs.

This case had been diagnosed yellow fever, from which one of this regiment was said to have died a few days before. We could not concur in the diagnosis.

The blood gave fine growths of a proteus rod, liquefying gelatin on the fourth day, coagulating milk on the fourth day, and without reaction in the sugar bouillons; also a staphylococcus aureus.

Case No. 20.—A. L. Atwood; army employee; aged about 30 years; was seen at the hospital "de los Angeles" on February 10, 1899, having entered on the 7th.

His skin was yellowish, and eyes injected (he had been unconscious on entry); pupils dilated; history (statement medical interne) of one attack of black vomit, at least of blood, and of several black stools; there was 40 per cent of albumen in the urine, which was scant; there was the statement of a temperature to 38.5°; this was then 37.6°; pulse, 84; blood taken from ear tip and planted.

On the 15th, there having arisen much discussion as to the diagnosis in this case, one consultant having diagnosed "gastric ulcer" and the other "yellow fever," we again saw the man. He presented undoubtedly yellow eyes; skin, the same; gums bled easily; the urine contained 20 ctgs. of dry albumen to the liter. While we at first, taking the statements of the attendants of this hospital in lieu of better records, of which none are kept of temperature and pulse, thought the case like yellow fever, we did not concur in the diagnosis, but could not concur in that of "gastric ulcer." The b. icteroides was *not* in his blood; the sputum was not examined.

He told us afterwards that he had had similar attacks before, and they had been styled "epileptic seizures," and always had resulted in unconsciousness and vomiting of blood; however, he could not recall any mention by his former physicians of albuminuria, a rather constant factor in hysteria and epilepsy, but of short duration, whereas this (40 per cent moist, and 20 ctgs. dry albumen to liter) lasted for several days or a week. The organism isolated from this blood was a staphylococcus, a tetrad and evidently a contamination, innocuous to animals. His blood serum, diluted 1–20, gave with b. icteroides a prompt reaction in the clumping and agglutination within half an hour.

Case No. 21.—Private Bradshaw, B Company, Eighth Infantry, United States Army; aged about 30; native American; was admitted to regimental hospital on the 20th of February, 1899.

He has a history of Santiago fever. The spleen is permanently enlarged; the bowel inclined to a diarrhea of pea-soup character. When seen on 23d the temperature chart showed morning remissions of an irregular type; there was a distended abdomen; pain over the valvular region; rose spots over abdomen; a red-bordered tongue, dry and fissured; a tendency to facial subsultus; urine with 5 per cent of moist albumen; there was some congestion of skin, as shown by finger pressure; facial expression listless; eyes not yellow. From the experience of the case of Patrick Smith, in the same regiment, this case was very closely watched by the attendants, but at this date we at once diagnosed a typhoid fever in its second week. Blood extracted from the ear tip; the urine and stool taken, and cultures made from them. From urine a proteus, a colon, and a leptothrix were isolated; no b. typhosus; from the blood there was isolated an actively translatory rod, not producing fermentation in lactose; coagulating milk on the seventh day; not liquefying gelatin; and since there was no indol production, it was placed as coli communis of rare type; no b. typhosus from feces. Injected into a pig, this organism, in 1 c. c. dose, reduced the animal 125 grams in twenty-four hours, and it was intensely ill, but slowly recovered.

Case No. 22.—A case of yellow fever seen by Acting Assistant Surgeon Menocal, M. H. S., who concurred in the diagnosis, extracted blood from the ear tip in bulbs, and transmitted them to us at Key West, Fla. These bulbs were kept from this time—April, 1898—until December of that year, when they were unsealed and their contents planted, from which there resulted mixed cultures of b. icteroides and b. coli communis, a surprisingly lengthy symbiosis in view of the declaration of Sanarelli that there exists so marked an antagonism between these organisms.

Of these foregoing 22 cases, the diagnosis was concurred in by one of us (Dr. Wasdin) in fourteen instances; in seven instances there was absolute nonconcurrence; in one instance, the case of Lannigan, No. 8, the diagnosis of yellow fever seemed correct at first, but was founded upon unreliable statements which seemed corroborated by the condition presented to us. The marked malarial seizures, however, soon questioned this diagnosis. In one instance, No. 14, there was no doubt whatever of the diagnosis, yet we did not isolate b. icteroides, although it was found by Dr. Meacham. In thirteen instances we isolated b. icteroides in pure culture.

Therefore, eliminating all reasonably doubtful cases and including the organism found by Dr. Meacham, we have the even percentage of isolations of the organism, the b. icteroides.

In the blood of yellow-fever cases extracted during life we have found bacillus icteroides in 13 of the 14 cases, with 1 negative—a per cent of 92.85. (In this negative case Dr. Meacham obtained it post-mortem.) From our necropsies we have secured it in 85.7 per cent, which includes the cases from which material was secured in New Orleans in 1897.

We have invariably demanded the completion of every requirement as advanced by Sanarelli in the identification of this organism culturally, beside which each organism has been tested as to its pathogenicity to animals, and we find that the germ exercises the same influence upon the lower animals, whatever its source.

The cultural and physiological characteristics of the bacillus icteroides are as follows:

Form: Small, fine, slender rods, 1.5 to 2 μ long, and three to four times as long as broad. Occurs singly or in pairs; short threads from cultures in bouillon, but never from solid media. Ends rounded, sometimes almost a cocco-bacillus in shape.

Motility: Very motile, with great directness of movement and very free translation across field of microscope. Flagella have been demonstrated.

Sporulation: Has *not* been observed.

Staining: Readily stained with all ordinary basic anilin dyes. Decolorized by Gram's method.

Aerobiosis: Is a facultative anaerobe.

Temperature: Grows best at 37°.

Agar-agar: On inclined agar at 37°–39° isolate colonies are thin, flat, grayish, circular. In two to three days colonies will present a peculiar appearance; a thick opalescent ring surrounding a flat, thin, transparent area. Outer border becomes transparent and original colony shows as opaque, embedded body. Agar streak culture—like typhosus—a thin, transparent growth.

Gelatin: Does not liquify. Gelatin (10 per cent) plates, 16° to 18°. characteristic colonies. Deep colonies are perfectly circular, sharp bordered, waxy; later dark, sometimes perfectly black; showing, possibly, in center slight radiating lines. Atypical colonies do not become black, are lobular, or surrounded by fibrils. Surface colonies resemble droplets of boiled starch or mucus; thick, convex, perfectly circular, or sometimes kidney-shaped. An opaque yellow-white nucleus can be seen at or near the center or at the hilum in the kidney-shaped colonies. It is opaque, finely granular, border sharp and smooth. Nucleus round, more often hat-shaped; in kidney-shaped colonies the crown of the hat is turned toward or projects into the hilum.

Milk: Is not coagulated.

Indol: Not formed, or very slightly; no production of nitrites.

Gas production: In 2 per cent exhausted lactose bouillon, no gas; saccharose bouillon, no gas; glucose bouillon, gas, $\frac{1}{H}\ \frac{2}{CO_2}$.

Bouillon: There is a diffuse growth without the presence of floccules, pellicle, or appreciable deposit.

Potato: There is an invisible moist growth.

Acid production: Slight in glucose; saccharose and lactose neutral reaction.

Pathogenesis: Pathogenic to rabbits, guinea pigs, rats, mice, dogs, cats, and monkeys.

It is unnecessary to remark upon these now well known attributes of the bac. icteroides, since the organism in pure culture has remained unchanged from the time of its discovery, and has proved to be the same in all respects wherever isolated. It may be mentioned here that in our earlier work with the organism, and owing to a misapprehension of the possible changes in our sugar media under certain conditions, we stated that there was no evolution of gas by its growth in glucose media, but later it was found that this observation was incorrect, and depended upon the facts given in our letter to the bureau upon this subject.[1] In this connection it may be stated that the varying reports from different observers as to the influence of this organism upon lactose depend upon changes produced in the molecular grouping of the constituents of this sugar by the application of too great heat in the preparation of its media. Hence if there is present in such media fermentation with gas production there is evidence of an inversion of a portion of the lactose by heat prior to the inoculation of the medium with this organism, which readily ferments the glucose thus formed, but has no power of inversion. The same may be said of saccharose.

Our attention has been called to a very striking similarity between the cultural and physiologic characteristics of b. icteroides and b. choleræ suis.[2] Our own observations lead us to state that, while there are singular resemblances, the b. choleræ suis differs from b. icteroides in presenting a grosser expansion, more distinctly slimy or ropy, a somewhat dirty appearance, on agar-agar slants, than does b. icteroides of the same age, which remains permanently clear and transparent. In bouillon cultures there is with icteroides no disposition to form ropy deposits, which are seen with choleræ suis. Also, we have not noticed any disposition on the part of b. choleræ suis to form the seal-like colonies, said by Sanarelli to be distinctive of his organism. Moreover, b. choleræ suis seems to have the property,[3] not possessed by icteroides, of forming sulphur compounds (H_2S), even in the absence of albuminoid material, as in the solution of Dunham, which can be demonstrated by appropriate reagents. Other differences between these organisms will be mentioned in another place. As stated above, we have made in each case every one of the demands before assenting to the fact that the organism isolated was the bac. icteroides, and in no case did we allow a cultural appearance, or several of them, to influence us in the adoption of the organism as the true icteroides until all requirements were fulfilled. We believe that serious error has resulted in the work of others from a neglect of this precaution.

ANIMALS ARE SUSCEPTIBLE TO THE INFECTION OF YELLOW FEVER.

The accepted methods of subjecting animals to the artificial influence of pathogenic organisms is in most cases above criticism—that is to say, artificial inoculations resulting in well-marked pathologic lesions in the bodies of animals *similar* to those found in such diseases in man must be considered as a fulfillment of the third postulate of Koch, even also of the fourth. But the same or similar pathologic lesions may be produced by different organisms introduced after these artificial methods, as the subcutaneous, intravenous, or intraperitoneal injections, and although there may be a difference in the quantity of the anatomic changes, yet there is the same quality of change.

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[1] Letter to bureau March 3, 1899.

[2] Reed and Carroll, Med. News, May, 1899.

[3] Observation by Geddings.

Thus with yellow fever practically the same lesions are produced in animals inoculated with the virulent varieties of the bac. coli communis as with that of yellow fever; and more recently the same observation attaches to bac. choleræ suis in mice and guinea pigs. We repeat that in animals which succumb to these artificial infections we find a marked similarity of appearance at necropsy, the difference being one of degree and not of kind. Moreover, we find that this observation applies to the results from the exhibition of the toxins of these different organisms.

We have had in our experience animal necropsies from the bacillus "X" of Sternberg, and from that of Havelberg, which could not have been told from those from bacillus icteroides. Especially has this been so in rabbits, whose livers do not become extremely steatotic. Therefore your commission could not accept the conclusion that Sanarelli had proved his position satisfactorily, and this led us to institute a series of experiments with susceptible animals, which we feel has resulted in the demonstration that the bacillus icteroides is the natural cause of yellow fever, and that those organisms which may produce similar changes in the organs when introduced into the tissues artificially *can not* produce the *acute infection* of yellow fever. Sternberg has contended that his bacillus "X" is identical with the bacillus icteroides of Sanarelli,[1] and the inference to be drawn from this contention that therefore bacillus "X" may be the cause of yellow fever is not surprising, since we have found bacillus "X" in a large number of our cases associated with icteroides, and "X" is capable of producing changes in the organs strikingly like those produced by yellow fever.

A case is recorded in which the colon bacillus has produced death in man, with anatomic lesions indistinguishable from those of yellow fever.[2] In this case the infection was artificial, since the b. coli communis has no natural infectiveness for man or animals, and was evidently derived from appendiceal abscess.

Therefore in these animal experiments made by "natural" infection the bacillus "X" and that of Havelberg, the two most prominent candidates for distinction, have been dismissed from further consideration after their failure to infect white mice, these rodents being considered the most susceptible animals to the acute infections.

On March 23, 1899, 2 p. m., we submitted 10 white mice, two in each cage, as follows, viz:

Cage No. 1.—Fed on bac. icteroides from Case No. 18 New Orleans 1 c. c. bouillon culture twenty-four hours old. Mouse C died on April 5 at 6 a. m., or twelve days and sixteen hours after exposure to infection.[3] Mouse D died on April 5 at 10 p. m., or thirteen days and eight hours after exposure.

Cage No. 2.—Fed on bac. icteroides from "Smith," twenty-four-hour bouillon culture on food. Mouse E died on April 1 at 5 a. m., nine days and three hours after exposure. Mouse F died on April 2 at 2 p. m., or just ten days after exposure.

Cage No. 3.—Fed on bac. "X" of Sternberg, twenty-four-hour bouillon culture on food. Mouse G, on April 24 in fine order. Mouse H, on April 24 in fine order. Both continued well thereafter.

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[1] Journal Am. Public Health Assn., Oct., 1898, p. 426.

[2] Annual Report M. H. S., 1898, pp. 437, 438.

[3] For necropsic findings on this and following animals see pages —.

Cage No. 4.—Fed on bac. typhosus (Král), twenty-four hour bouillon culture on food. Mouse I died April 1 at 5 p. m., or nine days and three hours after exposure. Mouse J was found dead April 16, after it had been transferred by an attendant to cage No. 2, which had not been sterilized. Just how long it had been in this cage could not be learned.

Cage No. 5.—Fed on bac. coli communis from hygienic laboratory, M. H. S.; twenty-four hour bouillon culture on food. Mouse K on April 24 was in fine condition. Mouse L was lost from cage on March 25, 1899.

Thus is seen that those animals subjected to the b. icteroides from two sources, No. 18 New Orleans, and from the case of "Smith" in Havana, all died; the organism more recently from Smith being most virulent. There was one death from typhoid infection; the other mouse died after exposure to b. icteroides, which were found in its blood, but not b. typhosus. Those subjected to the "X" bacillus and to coli communis did not at any time appear ill.

From these experiments it was not possible, since it is not practicable, to follow the health conditions of the rodents very closely, to formulate any idea of the *period* of *incubation*, nor of the duration of the disease, so that on the 20th April we exposed other mice, as follows:

Cage No. 6.—Fed on b. icteroides from "Smith," in bouillon. Mouse K^2: On April 24 we gave this mouse a bichloride bath, a new sterile cage and cotton, and placed with him a new mouse, K^3. K^2 died at 6 a. m., April 27, 1899, or six days and thirteen hours after feeding; left in cage three hours. Mouse K^3 remained well until May 8, when b. icteroides was added to the food. It died May 20, 1899.

In this instance mouse K^2 became infected during the first four days, but entirely failed to infect mouse K^3 or the cage, although left in the cage three hours post-mortem.

Cage No. 7.—Fed on b. icteroides from Smith, which had been scraped from a large plate culture and mixed with sterile lycopodium and dried slowly, and this powder dusted upon bread; the cage kept dry. Mouse L^1: On April 24, as with K^2, this mouse was given a thorough bichloride bath and a clean cage and cotton; also a new mouse, L^2; died at 12 m., April 27, 1899, or in six days and twenty-one hours. Mouse L^2 remained well until May 8, when b. icteroides was added to food; died May 28, 1899.

Again the infected mouse, L^1, failed to infect L^2, but, from the fact that the b. icteroides has been added to the food of L^2 on several occasions since May 8, we are inclined to believe that L^2 became infected and recovered, although, as we have said, it is very difficult to observe symptoms, save those of "extremis" in these small animals.

Cage No. 8.—Fed on bac. icteroides in lycopodium. Mouse M^1: On April 24, as in two above, the mouse was washed in bichloride solution and given a clean cage and cotton and a new mouse, M^2. M^1 was quite sick, but recovered. Mouse M^2 died May 4, at 9 a. m., ten days from time of exposure to the sick, M^1, in the clean cage.

Cage No. 9.—Two white mice were placed on bac. icteroides in their food on March 13, 1899. Mouse A died March 21 at 6 a. m., or seven days and eighteen hours from time of exposure. Mouse B died on March 22 at 6 a. m., or in eight days and eighteen hours from time of exposure.

From these instances it is seen that, with the exception of the mice K^2 and L^1, which were exposed to a cold bath of mercuric chloride solution 1-3,000 from three to five minutes, and which died in six days and thirteen to twenty-one hours, these animals died in from ten to twelve days. And since the mice exposed on April 20 in the three cages (K^2, L^1, and M^1) all became sick and were washed and changed on the 24th, it must be concluded that infection in mice takes place within the fourth day after exposure, and therefore that the duration of the disease, if uninfluenced (as by the baths), is from six to eight days.

Mouse N was fed upon b. icteroides, for the purpose of obtaining organs rich in virulent germs to be fed to the domestic pigs, on May 8, 12 m.; died on May 17, 8 a. m., or eight days and twenty hours after time of exposure.

These cases show a marked regularity in the influence of this organism upon white mice—that it is not invariably fatal to them, and that the bacillus of typhoid is also infectious naturally to them.

Again, a large white rat was caged and fed upon bac. icteroides from Smith, April 17, at 12 m. April 18, animal eats well; April 19, eats but is very quiet; April 20, eats little and appears ill; April 22, eats and appears better; April 24, eats and is better; April 29, eats well and appears well; apparently infected and recovered.

Also a large brown rat was caged and fed upon a bouillon culture (1. c. c.) in food of an organism styled "Williams's X," which, a note made at the time stated, we believed to be mixed with bac. icteroides. On 18th, eats well; 19th, eats well, appears warm, pants; 20th, eats a little, appears sick, pants; 21st, eats little, appears ill; 22d, eats little, appears ill; 23d, eats a little, appears somewhat better; 24th, eats a little, appears somewhat better; 25th, eats a little, appears somewhat better; 26th, eats a little, appears quieter and pants, much dyspnœa; 27th, eats; died at 12 m. of yellow fever. (See necropsy, page 33.)

From these larger rodents it is seen that the organism of Sanarelli is naturally infectious to them; that the period of incubation is about three days; that one recovered after several days of illness; therefore it is not invariably fatal to them; that in the fatal case the duration of the disease was possibly six days and eighteen hours, the incubation being counted as three, or nine days and eighteen hours from exposure. Also this animal's clinical history recalls vividly the history in human cases.

Other than these experimental mice, there have been observed three cases of natural infection within our general cage—mice "X," "XX," and "XXX." These were first observed either just before death or just after demise, and will be again referred to later on.

NECROPSIES ON ABOVE ANIMALS.

All these animals were necropsied, many of them at once, and all were placed in the refrigerator when found at inconvenient hours. These necropsies are as follows:

Necropsy mouse A.—Died 6 a. m., March 21, 1899. Much congestion of the vessels of the skin; the tissues are dry; the inner surface of the pelt is distinctly yellowish; vessels of the mesentery are engorged; the liver is engorged and apparently fatty; the spleen is enlarged and full of blood; the pleuræ seem normal, yet the lungs are much congested (tubes not examined); heart distended in right side; stomach contains a few spots of free blood; mucosa is ecchymotic and the submucosa stained; the duodenum is ecchymotic; kidneys are congested; the urinary bladder is empty. Cultures from organs and fluids. Liver saved for examination; the teased tissue in osmic acid solution shows much fatty degeneration of the hepatic cells, and the fat, extracted by trituration with ether from a given amount of liver and collected by evaporation on the surface of a water bath, gave 8.25 per cent of the liver weight in the moist state, and when dried and extracted it gave 29.5 per cent of liver (dry) weight, leaving no possible doubt as to fatty degeneration of a marked type. From the culture tubes we obtained a pure culture of b. icteroides; in this case there is no contamination, and this is made to fulfill all cultural demands according to Sanarelli.

Necropsy of mouse B.—March 22, 1899. Some rigor; vessels of skin congested; there are bloody sordes about mouth; the tissues are dry; the inner surface of the pelt is of a golden-yellow color; the mesenteric vessels are congested; the abdominal contents are distinctly yellow; the liver is congested and yellow from fatty change; the spleen is slightly enlarged; the stomach contains black vomit and duodenum the same; the kidneys are congested; the bladder contains a little urine, *bloody*, which shows much albumen when added to Esbach's picric acid solution; the heart contains much fluid blood; the lungs are congested, the right *not* collapsed fully; no increase of pleural fluid. Cultures from organs and fluids and intestinal contents (bloody). The organs and *urine* contain b. icteroides in pure culture; the tubes from stomach and duodenum show it in mixed culture. Amount of fat, by weight, in the moist liver tissue, 10.2 per cent; in the dried, 50 per cent. This little animal certainly gave a typical necropsy of yellow fever.

Necropsy of mouse C.—Dead from b. icteroides obtained from necropsy No. 18, New Orleans. Vessels of skin congested; inner surface of pelt yellowish; vessels of mesentery engorged; the liver mottled reddish and yellow, very fatty; the spleen slightly enlarged; the kidneys are swollen from congestion; bladder contains a little albuminous urine; heart is full of dark blood, left ventricle seems empty; lungs congested; pleuræ seem normal; the mucosa of stomach is bathed in yellowish mucus and contains several extravasations, but there is no *free* hemorrhage; the intestinal mucosa is congested and stained, and shows free hemorrhage at two points; cultures from blood and organs and intestinal content. Moist liver, 0.895 grams; dried liver, 0.345 grams; residue, 0.198 grams; fat, 0.157 grams; or moist, 17.5 per cent; dried, 45.5 per cent.

From these the blood and spleen gave pure cultures of b. icteroides; the liver and pericardial fluid gave cultures contaminated with b. coli communis; the intestinal cultures were of colon and bac. proteus viridens.

Necropsy of mouse D.—Dead from b. icteroides from necropsy No. 18, New Orleans. Vessels of skin congested; inner surface of pelt and muscular and tendinous wall, of a good yellow tint; vessels of the mesentery engorged; liver very fatty, yellow with some hemostasis in dependent portion; left heart contracted, right full of blood; fluid of pleuræ and pericardium yellow in tint; spleen a little enlarged; kidneys swollen; there is a pronounced yellow tint of the abdominal contents; urinary bladder empty; the stomach contains at least one spot of *free* hemorrhage, and the submucosa is stained; the duodenum contains two accumulations of free, "black vomit;" the lungs seem congested. Moist liver, 0.520 grams; dried liver, 0.123 grams; residue, 0.090 grams; fat, 0.033 grams; or moist, 6.35 per cent; dried, 27 per cent.

Cultures from organs and trachea and intestine. Of these the blood gave an unmixed tube of b. icteroides. The organism was also isolated from the *tracheal* mucus, but not from the intestinal mucus *free* from blood.

Necropsy of mouse E.—Dead from b. icteroides obtained from Private

Smith. There is yellowness of inner surface of skin; congestion of mesenteric vessels; liver a very bright yellow from fatty change; spleen not enlarged; kidneys swollen; heart in diastole, left ventricle empty; blood fluid; stomach contains black vomit, identical in appearance to that seen in man, the serum being absorbed by bibulous paper, and the changed blood remaining as dark fragments or granules in contrast; its mucosa is deeply blood stained, with punctate hemorrhages, and extravasations of large size; the duodenum is distended beautifully at several points with extravasated blood; urinary bladder empty; lungs seem normal, or of bright tint. Culture tubes planted from organs and fluids and the bloody intestinal content. Of these the heart and pericardial fluid gives pure culture of the b. icteroides; the intestinal tube plated gave the organism in pure colony. The liver examination gave for 0.894 grams moist, 0.305 dried; after extraction with ether 0.140 grams residue and fat 0.165, or 18.3 per cent of moist and more than 50 per cent of the dried liver. No necropsy could have been more typical than this one.

Necropsy of mouse F.—Dead from b. icteroides from Private Smith. There is yellowness of inner surface of pelt; fullness of skin vessels, also of the mesentery; the liver is yellow from fatty change; spleen is slightly enlarged; kidneys are swollen; the stomach contains black vomit, the same as in mouse E; the intestine contains in its upper folds numerous small collections of black blood; mucosa much stained and has upon it a grumous black deposit; there are numerous submucous extravasations; bladder is empty. Cultures from organs and fluids and intestine. From these the heart blood, spleen, and pericardial fluid gave a pure culture of b. icteroides; the tubes from intestinal bloody mucus gave the organism in mixed culture, but it was not plated out.

Mice G and H were fed, as stated above, on a pure culture of bac. "X" of Dr. Sternberg, obtained through the courtesy of Dr. Reed, of the United States Army laboratory, with the result that, while the others of this series, except coli communis, died in marked unanimity as to time, and exhibited the most marked similarity, except the one which died of typhoid infection, in all post-mortem appearances, they alone remained hearty and well and were returned to the cage in good order one month from the day of exposure, on which day all mice were treated *exactly alike*, i. e., 1 c. c. of a twenty-four-hour bouillon culture being placed in each cage, and none thereafter.

Necropsy mouse I.—Dead from b. typhosus (Krâl). Skin vessels congested slightly; inner surface of the pelt pale and clear bluish tint; vessels of the mesentery full; the liver is of a dark *slate* color; does not look fatty; spleen is enlarged and rather soft; kidneys are swollen from congestion; the bladder contains a little albuminous urine; the stomach and its mucosa are normal to the eye, the mucus white and glairy; the intestinal mucosa congested; heart and lungs normal to the eye. Osmic acid gives no liver degeneration. Cultures from organs, fluids, and intestines.

From these there were strange results; from the pericardial fluid a pure culture of the b. typhi abdominalis; from the blood (one tube), a pure culture (no other organism plated out) of bac. coli com., corresponding to that of Sternberg in that it coagulates milk on the third day; in lactose it forms gas, $\frac{2\quad 1}{H\ CO_2}$, in one-sixth of the tube; in glucose, gas, $\frac{2\quad 1}{H\ CO_2}$, in one-third of the tube; is only motile and not translatory; in Dunham's solution there is indol production; on potato the growth is a brownish yellow expansion. The spleen in bouillon culture gives an actively translatory rod, afterwards plated out in purity as b. typhosus; from the mixed intestinal culture, plated, the organism was not obtained.

Mouse J was fed on b. typhosus (Krâl) together with mouse I; remained well for some time after the death of mouse I on April 1, and was inadvertently placed by an attendant in a *dryer jar* (No. 2 of this series), and was found dead in this "Smith jar" on the 17th of April, from which mice F and E had died, the jar remaining in series uncleaned.

Necropsy mouse J.—Must have died on the 16th, for there is decomposition which shrouds appearances; the liver is somewhat yellow and fatty; spleen of normal size; in stomach the mucosa is covered with bloody mucus; there are evidences of much congestion in duodenum. Cultures from blood and organs. Those from heart and pericardium are pretty pure of a translatory colon which soon lost its motility, and which fermented all the sugars. This was replated but the b. icteroides was not isolated.

Mice K^1 and L were placed in same cage and given bouillon culture of bac. coli communis, a culture obtained from the laboratory of the Marine-Hospital Service, and which corresponded in all respects to the bac. "X" of Sternberg and to that of Havelberg, on the 23d of March, 1899. On the 25th L was missing from the cage and never seen again. However, from the plethoric condition of the mouse K^1, it is thought that she ate the smaller L.

Mouse K^1 was alive and perfectly well on the 24th of April, or one month from date of exposure, and remained permanently so.

This series of necropsies proves the acute infectious character of bac. icteroides to rodents; that the post-mortem appearances are the same in all cases; that they resemble closely those observed in the human body after death from yellow fever; that bacillus typhosus is less markedly infective, and the post-mortem lesions are less marked; that with bac. icteroides the "secondary infection" by other germs is not so marked, the blood and organs giving, in many cases, pure culture of the organism, a few giving also colon, or proteus; that staphylococci and streptococci were practically unknown in these cases; that in all except mouse I the hepatic cells were extensively fatty, teased fresh preparations in osmic acid showing this change, while in that of I there was only cloudy swelling, with further necrosis; finally, that while bac. "X," and others of the common colon group, when injected into the tissues of these little animals do give rise to a more or less fulminant illness and death, the organs showing a marked degree of steatotic change, the stomach containing at times "black vomit," there is no infectiveness attaching to them either for man or animals—i. e., they are pathogenic under artificial conditions, but not naturally, or infective.

Necropsy mouse K^2.—Dead from b. icteroides from Smith, April 27, noon. Much congestion of the vessels of the skin; yellow tint on its inner surface; tissues are dry; vessels of mesentery engorged; liver is very yellow from fatty change; spleen is normal in size, friable, and dry; lungs are much congested, and there is some lobular pneumonia; right heart full of liquid blood; kidneys swollen; stomach contains only a little "black vomit," no débris of food; duodenum contains free blood; urine is albuminous; liver, moist, 1.220 grams; liver, dried, 0.318 grams; residue, 0.188 grams; fat, 0.130 grams; or moist 10.6 per cent, dried 40.9 per cent. Cultures from organs and fluids; from which heart and spleen give pure cultures, b. icteroides; the others are mixed from trachea, liver, and pericardial fluids.

Necropsy mouse K^3.—Dead from b. icteroides from Smith, April 20, 1899. Vessels of skin and mesentery intensely engorged; liver very fatty; spleen normal in size; stomach and duodenum contain free blood as "black vomit;" the lungs are congested; cultures from blood from which the organism was plated in pure culture.

Necropsy mouse L^1.—Dead from b. icteroides from Smith. Tissues dry; vessels engorged; those of the mesentery, also; liver very yellow and fatty in appearance; spleen normal in size; heart in diastole; lungs congested with patches of broncho-pneumonia; kidneys are congested; the bladder entirely empty; the stomach mucosa has many punctate and free hemorrhages; small intestine the same; cultures from organs and fluids.

After forty-eight hours the spleen and liver give pure cultures of b. icteroides; the blood of heart gave the organism mixed with a straight motile (translatory) bacillus twice as long as that of Sanarelli. There were some colonies from the trachea and bronchi, but these animals are so small that it is impracticable to enter these tubes without the danger of encountering free blood, which, containing the bacillus, questions the integrity of the observation that the organism exists in the tracheal or bronchial mucus in pure culture.

Mouse M^1 died from b. icteroides and fed to domestic pigs, without necropsy.

Necropsy mouse M^2.—Dead from b. icteroides, from Smith through M^1. Dead five minutes; tissues dry and yellowish; mesentery engorged; liver yellow; spleen slightly swollen; kidneys swollen; lungs congested; left heart firmly contracted; right full of blood; ecchymoses on diaphragmatic pleura; bladder empty; the stomach contains 2 c. c. of a dark-brownish fluid, with flakes of black substance (black vomit); the mucosa extravasated at many points; small intestine has some free blood. Liver, fresh, 1.100 grams; liver, dried, 0.350 grams; residue, 0.165 grams; fat, 0.185 grams; or moist, 17 per cent; dried, 53 per cent. Cultures from all organs and fluids.

The organism of Sanarelli is regained from blood and spleen. From the trachea and tubes it is in mixed cultures.

Necropsy mouse N.—Dead from b. icteroides. Liver is very yellow and fatty to cut and feel; stomach contains blackish fluid; mucosa is extravasated; urine albuminous; cultures from blood and spleen, from which results a pure culture from spleen; organs fed to two domestic pigs.

Necropsy of brown rat fed on mixed culture from stomach of Williams, dead from yellow fever.

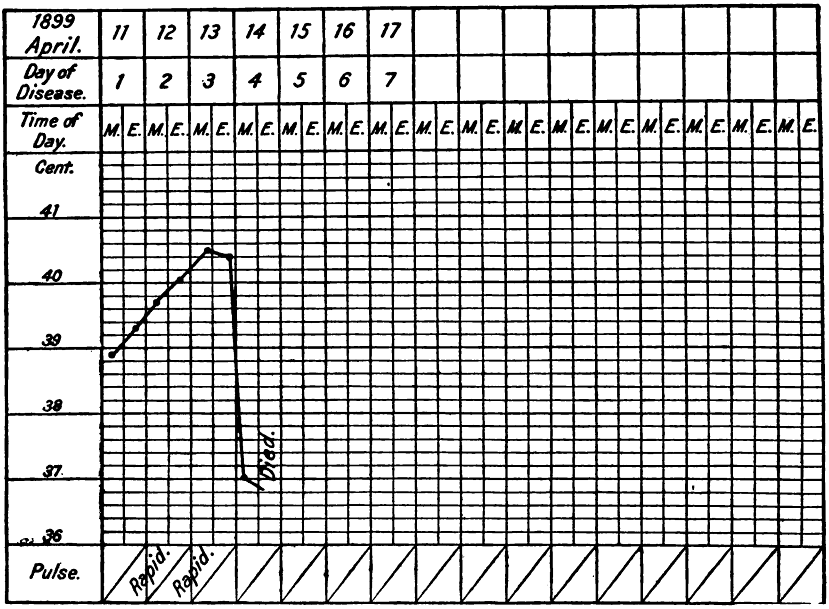
Vessels of skin full; tissues dry and yellowish; inguinal lymph glands enlarged; vessels of mesentery engorged; liver is congested and presents plaques of bright yellow change, with red areas; there is a large tapeworm encysted between the lobes; the stomach mucosa shows numerous punctate hemorrhages, some of them free on the surface; duodenum the same; spleen normal in size; kidneys congested; urine albuminous; lungs studded with cheesy deposits, some of them as large as buckshot; many of these upon visceral pleura; the glands at the roots of the lungs generally enlarged; there are also numerous cysts containing parasites; heart full of fluid blood; cultures from organs and fluids; cover slips from cheesy material. The jaws were broken and mucus from trachea and bronchi obtained *free* from blood.

From these cultures the spleen gave a pure colon, at first translatory, but later permanently immotile; other tubes sterile. From the bronchial mucus we isolated readily the b. icteroides in pure culture. The covers stained showed no tubercle bacilli in cheesy nodules. This was the only b. icteroides that we were able to isolate from this case, and the possibility of its having gained entrance to this cage from some others near it must be considered, and especially would the disease of the lungs predispose it to infection.

OTHER EXPERIMENTS CHIEFLY BY INSUFFLATION.

In the endeavor to submit animals to the influence of the bac. icteroides in as natural a manner as possible the twenty-four hour old culture, scraped from large agar plates, was mixed with lycopodium powder in good proportion and slowly dried at incubator temperature. This could be used at the end of twenty-four hours in an ordinary powder blower, the animals being confined in a close box, the tube nozzle passed through a small opening. Insufflations were generally of three-minute duration.

[Dog A.—Disease, yellow fever.]



On March 10, 1899, a good-sized dog, A, was fed with food impregnated daily with b. icteroides from several sources until the 25th, when she appeared quite well. On the 25th we incised the abdominal wall (laparotomy) and, withdrawing a loop of the small intestine, carefully injected into its lumen 2 c. c. of a twenty-four hour bouillon culture of b. icteroides, from No. 18 New Orleans, under chloroform. Reaction was good. On 26th no bad results, eats well; 27th no bad results, eats well; 28th no bad results, eats well. April 1 she is well. On April 4 she was chloroformed and tracheotomized and a tube placed in trachea. On the 7th she is quite bright and eats well, and tube in good condition. At 1 p. m. the lungs were insufflated with a freshly prepared powder, bearing the b. icteroides (from Smith). Until the morning of the 11th she gave no sign of illness, but then we were informed that she was sick, and found that she had aborted a nearly full-grown pup, and was quite ill, there being free hemorrhage. Temperature high; pulse rapid. On the 12th she is very ill; lies down, and does not notice food; there is a free hemorrhage. Blood taken from ear vein and planted. On 13th blood again planted. On 14th dead at 9.30 a. m.

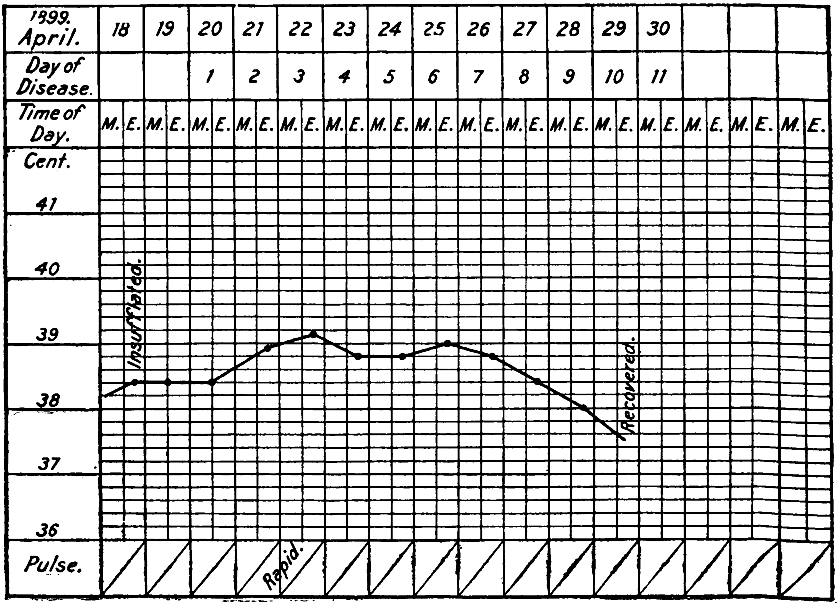
Necropsy (*at once*).—Tracheotomy tube clear and no hemorrhage or pus; old abdominal incision nicely healed; tissues dry; mesentery very fatty, obscures congestion; the liver presented a perfect appearance of yellow, fatty change, with dilated venous radicles imparting a "nutmeg" appearance; there were large, bright yellow plaques, and it was generally yellow when cut; gall bladder was full of clean bile; spleen normal in size and dry; kidneys swollen and on incision gave perfect pictures of fatty change in the cortex at the bases of the pyramids; bladder was almost empty, the few drops of urine becoming solid albuminous flakes when dropped into picric acid solution (Esbach's); there was some free blood in the abdomen from a rupture of a small vessel in the gastroduodenal mesentery; pericardium was ecchymotic on both layers, some spots being 1 cm. in diameter; they were most numerous upon the visceral layer; the fluid was increased and yellow; the heart muscle was pale, left ventricle contracted, right full of black fluid blood; the diaphragmatic pleuræ were ecchymotic, also the visceral layer; fluid scant and yellow; the lungs were contracted and of a deep red color; the bronchial mucosa inflamed and bathed in muco-pus; the stomach contained 250 c. c. of a "dark grumous fluid," or black vomit; the mucosa was ecchymotic and stained, covered with a glairy mucus which entangled numerous flakes of the blackened blood; the duodenum gave the same picture, the small intestine beyond being intensely engorged, with here and there free blood; the uterus was enlarged; its peritoneal covering ecchymotic; one horn was full of clot and placenta, the other was hemorrhagic and empty. Moist liver, 10.000 grams; dry liver, 2.676 grams; residue, 1.658 grams; fat, 1.018 grams, or 10.18 per cent wet, 38 per cent dry. Cultures from all organs, blood, bile, and urine and fæces. The cultures from living blood rested sterile. The liver and urine gave pure cultures of other organisms; the other tubes were sterile. That of the liver was a very coarse rod, motile, truncated, and growing on agar as a dense opaque layer, assumed to be a hay bacillus of accidental contamination; that from the urine was an immotile bacillus, having no similarity to b. icteroides. Growths from the fæces were plated with no result, so that b. icteroides was *not* isolated from this animal; the bronchial mucus was not planted. From the time elapsed between the feeding experiment and the introduction of the germ *beyond* the acid stomach into the intestine, as well as the subsequent typical period of incubation, from the 7th to 11th, and inception of the disease, its typical course, and ending with so perfect a necropsy, it must be assumed that this was a pure, or natural, infection, the insufflation having been an exaggerated *inspiration* of the bacillus. The absence of all organisms from the blood and organs (the mucus from the trachea and tubes was unfortunately overlooked) was readily attributed to the well-known bactericidal power of the serum of these animals; but later observation showed that this was also the case in rabbits, whose serum is not so potent. Professor Sanarelli always exhibited his organism in dogs intravenously, and, of course, in great numbers, since as high as 20 c. c. were at times injected, most of his experimental records showing that death was due to the toxins injected, an intoxication, rather than to the bacillus, and that their presence in the blood and tissues was simply because they were in such numbers as to resist destruction, a number of his dogs requiring *several* intravenous injections. This would not have been the case if a true multiplication of the bacillus had taken place, an active septicæmia, and it is probable that this can not take place in the dog, or, in other words, that the dog, naturally very resistant to yellow fever, does not develop naturally a septicæmia as a "secondary infection" in this disease. In dog A the disease followed a natural, if slightly exaggerated, process, and from 5 p. m. of the 13th, when she was so nearly dead that we feared a demise during the early hours of the night with the "secondary invasion" from *possibly* the alimentary canal of a horde of organisms, until her death, at 9.30 a. m. of the 14th, there was surely ample time in these "last hours of life" for this secondary invasion. She was operated upon while still warm; a few hours post mortem this invasion might have occurred. Had Sanarelli used cultures of the bac. coli communis the same results would have been reached as with his experimental methods in dogs, and the same can be said of his experiments with the filtered cultures (toxins) in man, that while they proved *toxicity*, there was absolute lack of proof that b. icteroides was *infectious*. Since two different bacilli can give rise to similar intoxications, the one can not be called more or less than the other the specific cause of an acute infectious disease unless the experiment shows the manner of such infection to be one not natural to the other.

On April 7 we placed a young guinea pig of 250 grams and a rabbit of 700 grams in a close box with a small opening for insufflator tube, and insufflated them for ten minutes. When removed from the box their coats were well dusted with the powder. On the 8th this was repeated for five minutes. On the 17th they were perfectly well and returned to general cage.

On same date we tracheotomized a young rabbit and introduced a glass tube, under ether. On the 8th insufflated the lungs through the tube for several minutes with the powder containing the bacillus icteroides. On the 9th the animal died suddenly from choked tube. All organs and blood sterile. (Lung not examined.)

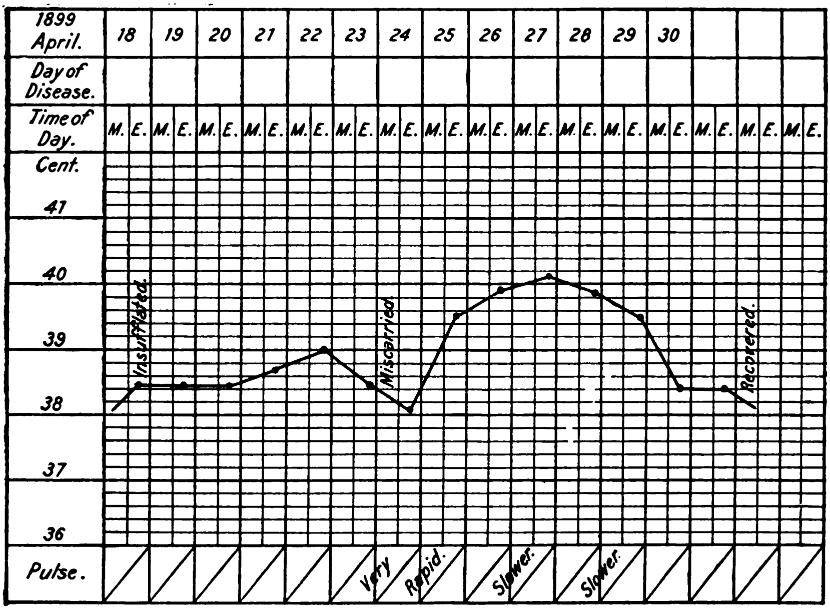
On April 15 and 16 we tracheotomized as above three dogs under chloroform; all reacted well.

[Dog B.—Disease, yellow fever.]



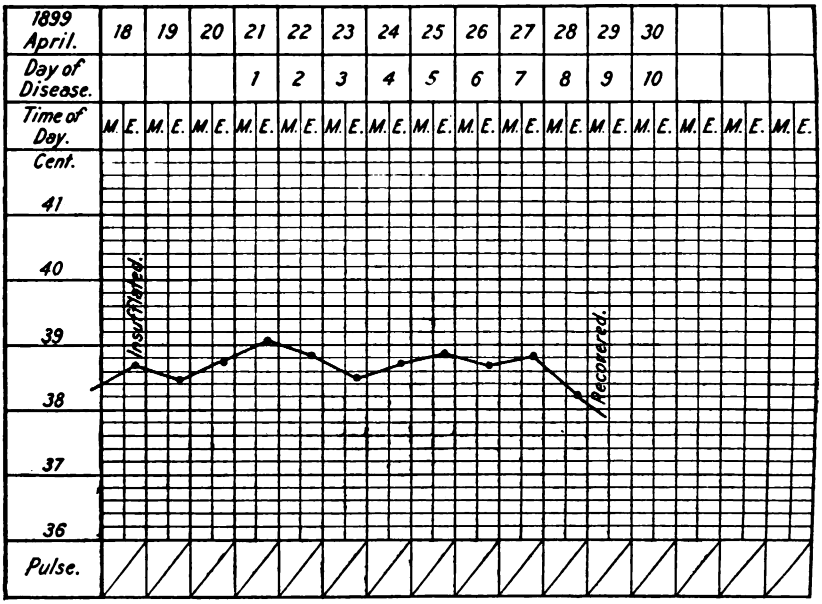
April 18, dog B, a plump male of 7 kilos, native; wound partially healed and in good condition; was insufflated with b. icteroides in lycopodium for two minutes; vomited in ten minutes. April 19, doing nicely; again insufflated two minutes. April 20, doing nicely; eats heartily. April 21, doing nicely; eats fairly. April 22, doing poorly; eats little; seems sick; nausea. April 23, doing poorly; eats little; is right sick. April 24, doing poorly; eats little; blood taken from ear. April 25, doing poorly; eats little; reclines a great deal. April 26, doing poorly; eats little; more active. April 28, doing well; eats much better; recovered; blood from ear rested sterile in bouillon.

[Dog C.—Disease, yellow fever.



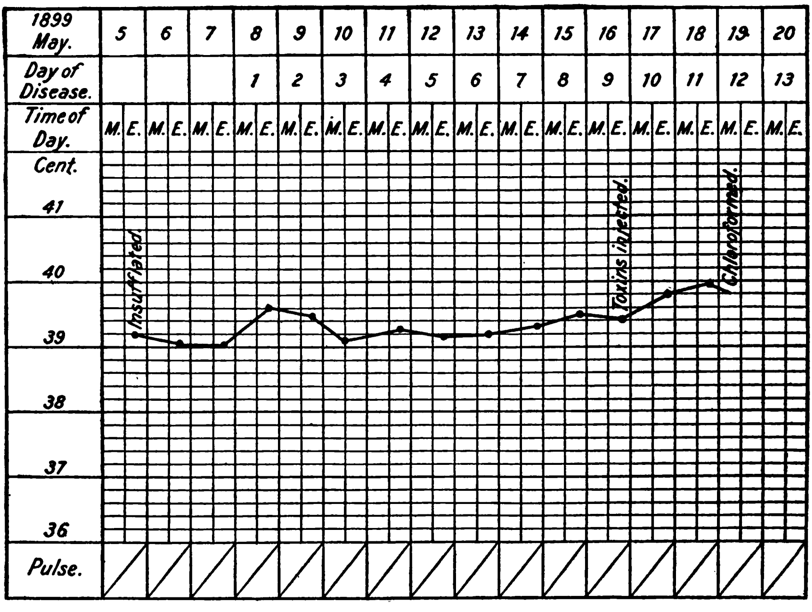
April 18, dog C, a pregnant female of 5,850 grams, native; was insufflated through tube with bac. icteroides in lycopodium for two minutes. April 19, fairly well; tube clear; again insufflatedtwo minutes. April 20, fairly well; eats heartily. April 21, fairly well; eats heartily. April 22, fairly well; eats little; blood taken. April 23, fairly well; eats little. April 24, only poorly; pupped five pups; look premature. April 25, 26, and 27, only very poorly; pups not cared for; two dead; blood taken. April 28, only poorly; does not eat; blood taken. April 29, only poorly; eats a little and cares for pups. April 30, better; eats well and cares for pups. May 8, she is in fine condition; another pup accidentally killed; ear-tip blood always sterile in bouillon.

[Dog D.—Disease, yellow fever.]



April 18, dog D, small tan female, 4,370 grams; insufflated with b. icteroides for three minutes; April 19, has lost her tube; April 20, eats well; April 21, eats well, seems quiet; April 22, eats poorly; April 23, eats poorly; April 24, eats poorly; April 28, eats well, seems as usual. Ear-tip blood always rested sterile in bouillon.

[Dog G.—Disease, yellow fever.]

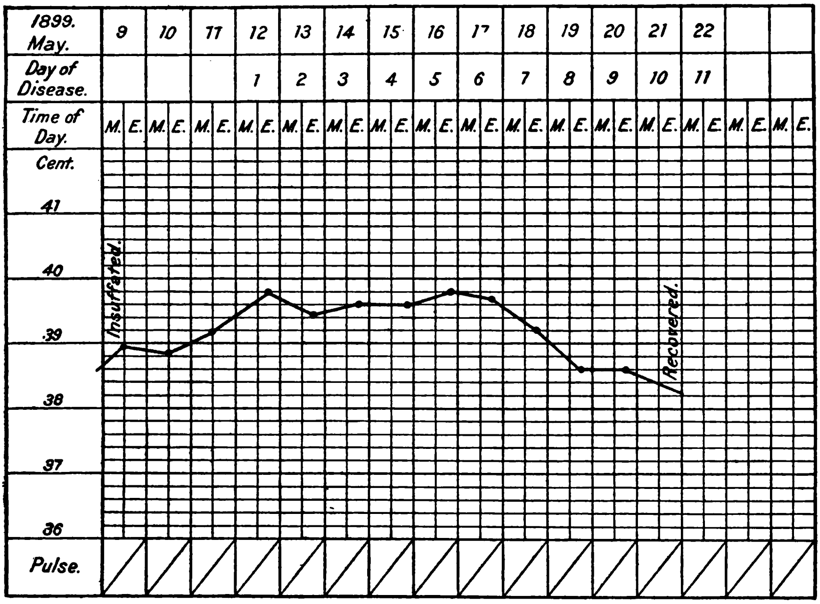


May 5, dog G (a Tampa reagent), was chloroformed and insufflated through the larynx with b. icteroides for two minutes. May 6, eats very little and appears sick; May 8, eats better, appears better; May 9, eats but little; May 11, eats but little, coughs much; May 12, eats little, is ill; May 15, eats little, coughs much; May 16, eats a little better; gave 5 c. c. soluble toxins and there was immediate nausea and other symptoms; May 17, eats a little, is better, coughs much; May 18, eats nothing, is quite sick. He was chloroformed.

Necropsy showed normally colored liver and enlarged spleen; mucosa of stomach injected; from the duodenum to the ileo-cæcal valve the intestinal mucosa was much congested, and here and there were minute extravasations; visceral pleuræ ecchymotic; lungs deeply congested; mucosa of tubes normal, some deep mucus; bladder has 25 c. c. urine, slightly albuminous. Moist liver, 7.465 grams; dry liver, 1.910 grams; residue, 0.370 gram; fat, 0.540 gram, or 7.2 per cent of the moist and 28.3 per cent of the dried liver. Cultures from blood and organs all remained sterile, even the *bronchial mucus*.

In this case death would probably have ensued from the exhibition of the soluble toxins, since to it alone can be attributed the anatomic results.

[Rabbit No. 29.—Disease, yellow fever.]

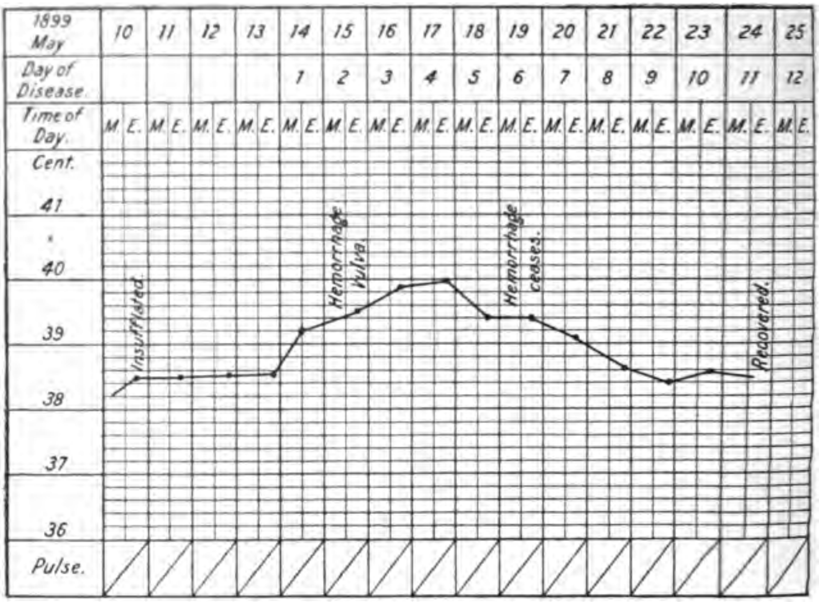


May 9, insufflated through larynx, without anæsthetic, with b. icteroides, a large buck rabbit, No. 29. May 10, appears well; May 11, appears droopy, eats little; May 12, appears droopy, eats little or none; May 13, appears very droopy, dyspnœa, eats little or none; May 14, appears easier; May 15, appears easier, eats little; May 17, appears easier, eats better; May 20, appears well.

May 10, No. 30, a medium-sized female rabbit was insufflated without anæsthetic, with b. icteroides for three minutes. May 13, very quiet, eats little; May 14, very quiet, eats little; May 15, very quiet, lying down, free hemorrhage from vulva; May 16, very poorly, lying down, eats none, bleeding; May 17, very poorly, lying down, eats little, bleeding; May 18, very poorly, lying down, eats little; May 19, very poorly, lying down, eats little, no more blood; May 22, much better, eats some; May 25, seems well, eats well.

These two animals reacted very slightly; they were sick, as the charts

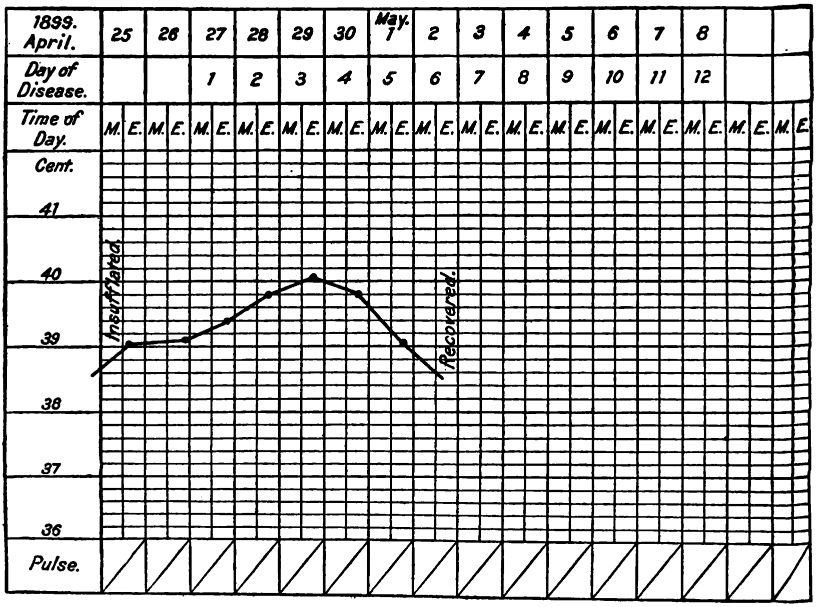
[Rabbit No. 30.—Disease, yellow fever.]



show, but it was very mild. Blood taken on the 15th and 16th and planted in bouillon gave no growths; that is, there was no septicæmia.

May 9, dog H, a small female, of 3 kilos, native of Florida, was insufflated through the larynx without anæsthetic. From this date to 17th the temperature ranges from 38.6° to 39°. There is *no* reaction; the dog eats well and is well. No result. May 20, injected into trachea of same dog through the skin 1 c. c. suspension b. icteroides. There is no reaction in temperature. There is a paresis of right fore leg and a chronic spasm of muscles of right shoulder, yet she walks, but reclines much. May 27, eats well; temperature, 38.7°; she is running any where; well.

[Rabbit No. 40.—Disease, yellow fever.]

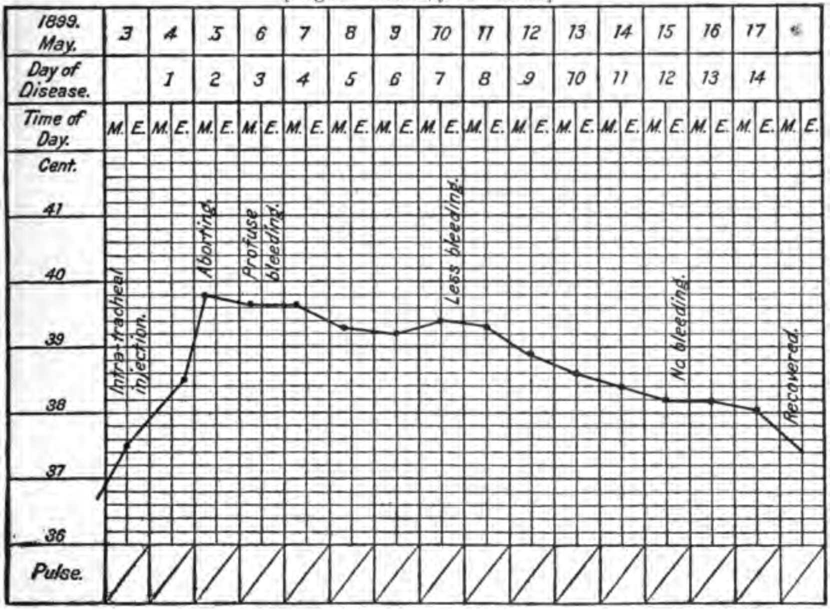


April 25, insufflated the trachea, through larynx, under ether, of two rabbits, one a large male from Washington, the other a small female, No. 40. During the fever this animal ate very little and became emaciated. Blood drawn proves sterile. May 1, recovered. The large male scarcely reacted, his best temperature being 39.8°; his normal about 39.3°.

We believe the fumes of the ether influenced these cases and discontinued its use; also, that the condition of the organism, whether in dust or fluid, matters little, so long as the bacillus reaches the tubes. We gave some intratracheal injections of b. icteroides in bouillon.

On May 3, 1899, dog E, large female, pregnant; weight, 23 kilos.; a native of Florida and nonimmune; temperature, 37.5°; was etherized and the trachea exposed, into which, by means of a sterile syringe, 0.5 c. c. of bouillon culture of bac. icteroides was injected, the needle wound being treated with bichloride as the instrument was withdrawn. May 4, appears well, eats heartily; 5 p. m. she has chills. May 5, at 8 a. m. she is aborting and eats the embryos. May 6, at 10 a. m she is ill and flooding profusely and lies down continually. May 7, at 10 a. m. she is up and eats a little; some blood. May 10, at 10 a. m. she is better; some blood. May 15, at 10 a. m. she is better; no blood. May 17, practically well, and eats well; no blood.

[Dog E.—Disease, yellow fever.]

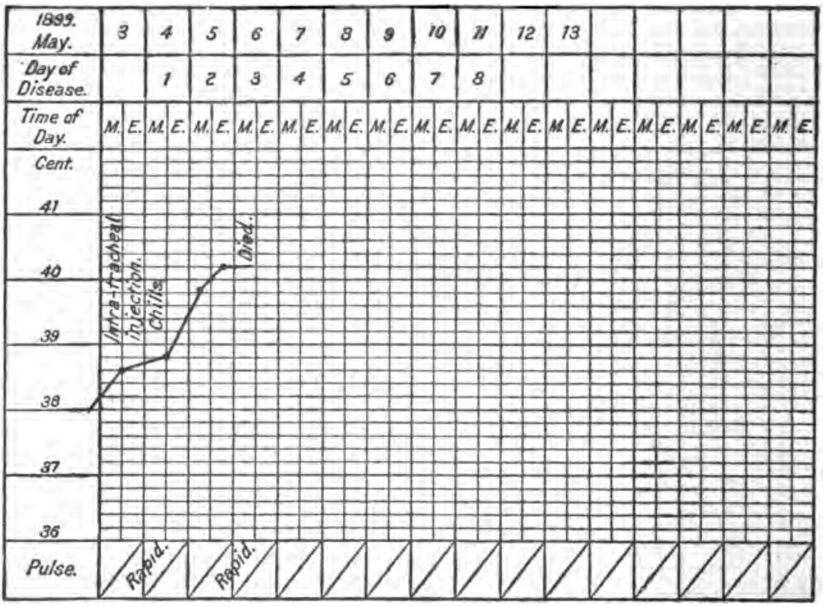


In view of the experience with dog A, into whose jejunum was put 2 c. c. of bouillon culture of b. icteroides without any symptoms whatever, we must conclude that the symptoms in this animal were not altogether due to the small amount of toxin in the 0.5 c. c. injection, but to an increase of the organism introduced and the quick response to the rapid increase of an already formed (in bouillon) colony.

Dog F, the same as dog B, still wearing his tracheal tube, was injected through the tube with 0.5 c. c. bouillon culture b. icteroides on May 3, 1899. May 4, animal seems as usual; eats very little. May 5, animal at 8 a. m. has chills; nausea, tracheal secretion. May 5, at 2.30 p. m. died in convulsion.

Necropsy (*half hour post-mortem*).—There is rigidity; lividity of lips and tongue; skin vessels full; those of mesentery engorged; liver deeply congested, but yellow in large plaques; spleen is enlarged; kidneys are congested; bladder is empty; the pleuræ have ecchymotic spots; the lungs are much affected; of the right lung the two lower lobes were deeply congested and there was broncho-pneumonia, the lung floating very deeply in water bath; the left lung gave a semisolid lower lobe; the trachea and bronchi were full of a muco-pus; the mucosæ ecchymotic even into the smaller tubes; pericardium and fluid normal; right heart full of black fluid blood; the stomach contains 100 c. c. of dark bloody fluid; the mucosa is extensively extravasated; in the duodenum the picture is the same. Cultures from everything. In forty-eight hours' incubation this dog's organs and blood prove *sterile*, as in A. The cultures from trachea and tubes and cut lung surface gave the b. icteroides injected, mixed with other organisms. Liver teased in osmic acid showed much fat. Fat in fresh liver, 9 per cent; dried liver, 33 per cent.

[Dog F.—Disease, yellow fever.]

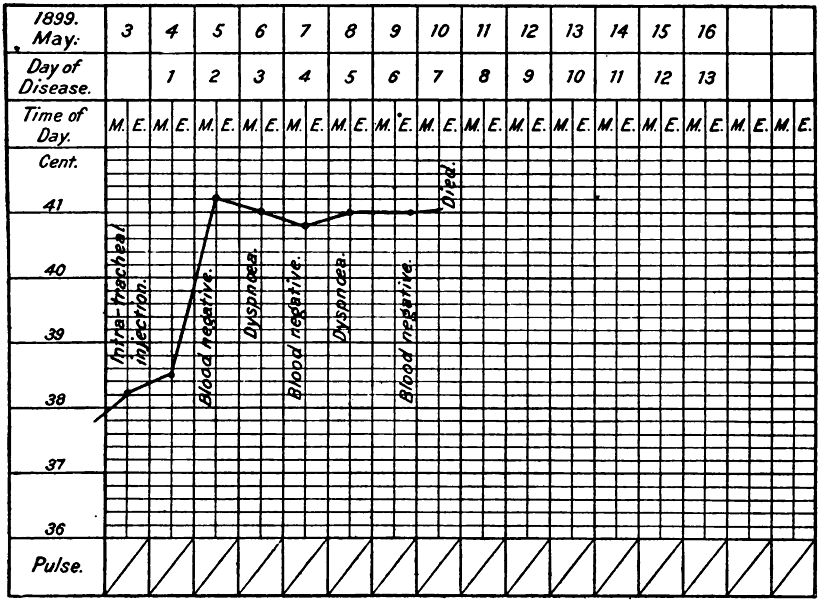


The prompt reaction in this case, I think, arose from the fact that this dog had had some difficulty in wearing his tube, and the lungs were in a condition of semicongestion most suitable for infection. We can not explain the questionable reaction in the case of this dog as B.

On May 3, 1899, a small rabbit, No. 15, was etherized, the trachea exposed by incision, and 0.5 c. c. bouillon-culture b. icteroides (Smith) injected by syringe into its lumen; the wound carefully disinfected; reaction, good; temperature, 38.3°. May 4, animal eats well, seems well. May 5, animal eats little, is sick; dyspnœa. May 7, animal eats nothing; breathing badly. May 8, animal eats nothing; blood planted. May 9, animal is dead at 8 a. m.

Necropsy (*at once*).—Much emaciation; rigidity; vessels of mesentery engorged; liver deeply congested, but *not* yellow; spleen, normal; kidneys, congested; right heart, distended; the pericardium purulent; pleural fluid opalescent, membranes inflamed; the lungs deeply congested, with scattered points of a lobular pneumonia; tubes contain a free muco-purulent secretion; the stomach contains a bolus of undigested food, deeply stained from numerous free hemorrhages from the mucosa; that of duodenum deeply congested and extravasated; urinary bladder is empty; cultures from all sources. This is not a characteristic post-mortem, still the hepatic cells teased in osmic-acid solution showed numerous black granules of fat in a larger number of them; others were granular, with fragmenting nuclei. After forty-eight hours' incubation, the blood drawn and planted on the 8th remained sterile. The tubes from pericardial pus and pleural fluid gave pure cultures of b. icteroides, the pus carried into various media giving all demands of Sanarelli. *All other tubes sterile.* Stained cover slips of this pus gave numerous rods among the leucocytes, many of them already engulfed by the large multinuclear cells. There was *absolutely* no other organism in these fluids.

[Rabbit No. 15.—Disease, yellow fever.]

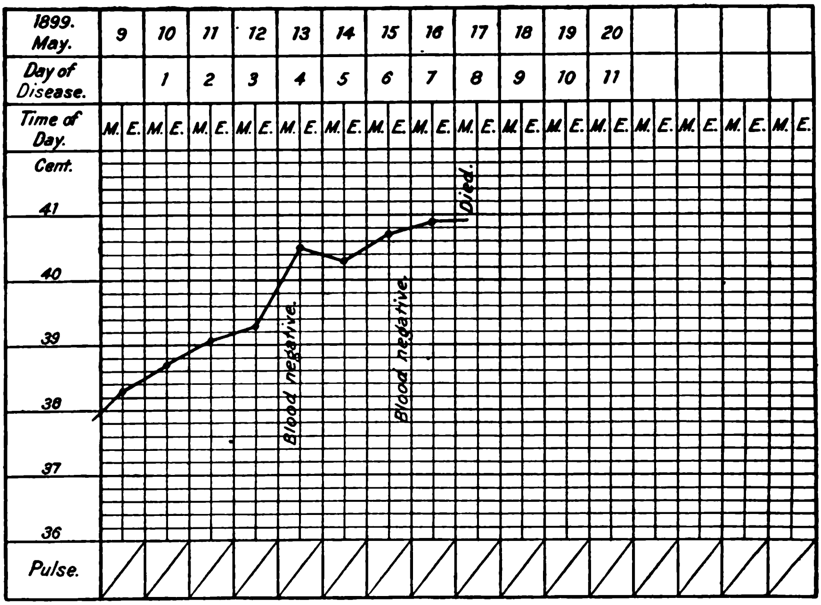


May 9, exposed trachea of a small rabbit (No. 25) and injected into its lumen 0.5 c. c. of bouillon culture of b. icteroides (Smith). May 10, animal coughs and eats little. May 11, animal crouches; eats little, and coughs. May 14, animal lies all the time; eats nothing; coughs. May 15, animal lies all the time; eats little; blood planted. May 16, dies at 4 p. m.

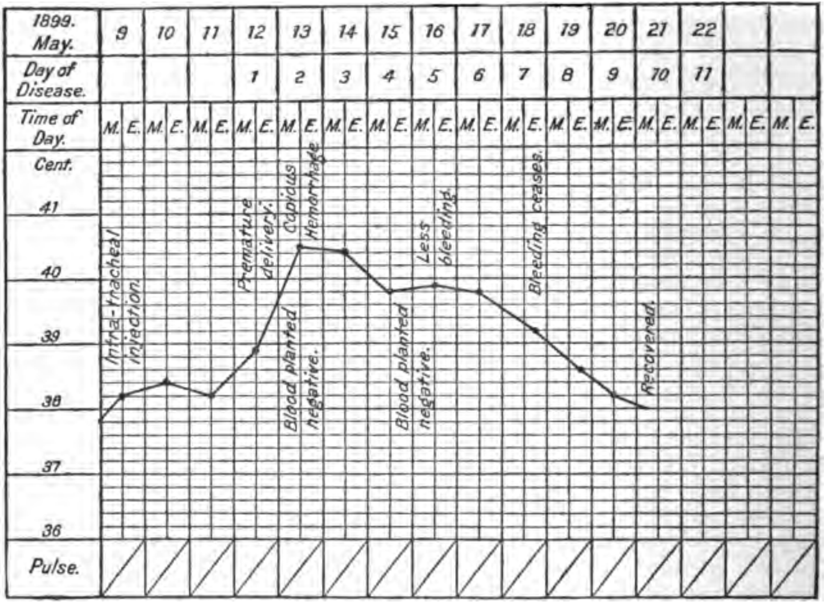
Necropsy (*at once*).—Much emaciated; vessels of skin and mesentery engorged; liver somewhat yellow; spleen normal in size; pericardium normal; right heart distended; left contracted; the trachea and bronchi inflamed and full of muco-pus; pleuræ ecchymotic; the lungs show many lobules shrunken from pneumonic change; the mucosa of the stomach is ecchymotic, as is that of the duodenum; there is no free hemorrhage; urinary bladder empty; gall bladder full; cultures from all organs and fluids. Moist liver, 8.660 grams; dried liver, 1.689 grams; residue, 1.305 grams; fat, 0.384 grams, or 3.8 per cent wet and 22.8 per cent dry.

After forty-eight hours incubation *all tubes remained sterile* except those taken from the *trachea*, *tubes*, and *lung surface*, which gave the b. icteroides in mixed culture, from which it was readily isolated pure. Blood planted on 13th and 15th *remained sterile.*

[Rabbit No. 25.—Disease, yellow fever.]



[Rabbit No. 27.—Disease, yellow fever.]

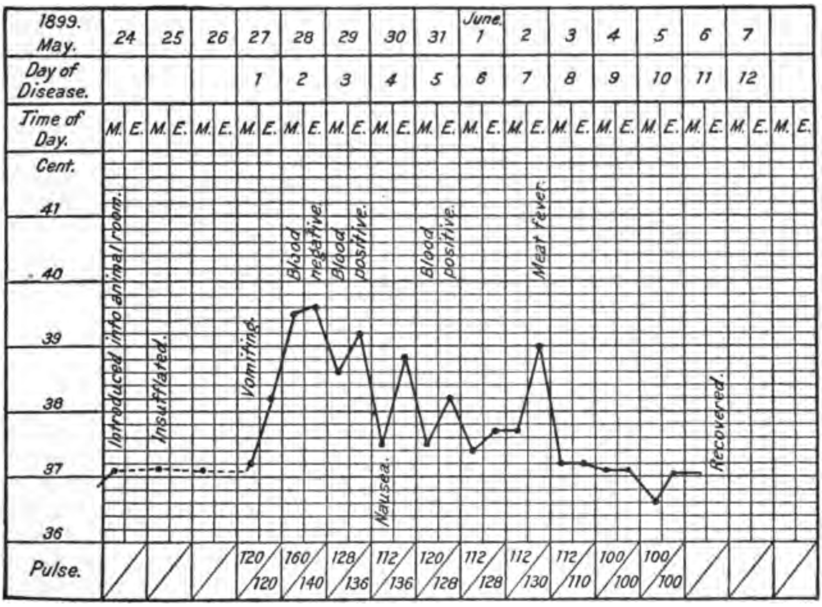


May 9, a large female rabbit, No. 27, pregnant; was inoculated through the trachea with 0.5 c. c. bouillon culture b. icteroides. May

10, animal quiet. May 11, animal quiet; eats some. May 12, animal gives birth to eight young; immature. May 13, animal has bloody lochia; eats little; blood planted. May 14, animal has bloody lochia; eats better. May 15, animal seems better; eats better; blood planted. May 17, animal seems better; cares for young nicely. May 20, animal is well; two pups are dead from starvation; the others are very emaciated; four are placed on the bottle; all died.

May 23, 1899, at 6 p. m., introduced into our animal room a large black ape for experimentation. May 25, at 10 a. m., the trachea was insufflated through the larynx for three minutes with lycopodium powder bearing b. icteroides in good quantity. There was no doubt of its having been inhaled, since the animal sneezed and coughed freely. Temperature, 37.3°. May 26, again insufflated freely. During afternoon the animal seems dull. May 27, at 8.30 a. m., it has a vomiting spell; appears dull; does not eat much. Axillary temperature, 37.4°; pulse, 120. Again insufflated for several minutes. May 27, at 5 p. m., axillary temperature, 38.4°; pulse, 120; slight diarrhea; is restless and somnolent. Milk diet. May 28, 9 a. m., temperature, 39.5°; pulse, 160; is quite ill; lies down and takes little notice. Blood from ear tip planted. Does not touch food. Five p. m., axillary temperature, 39.6°; pulse, 140; seems very weak and depressed; has craved water all day. May 29, 9 a. m., temperature, 38.6°; pulse, 128; animal is not better this morning; seems quite ill; much thirst; lies down. Blood from ear tip planted. Five p. m., temperature, 39.2°; pulse, 130; some diarrhea.

[No. 1, African Ape.—Disease, yellow fever.]



May 30, 9 a. m., temperature, 37.5°; pulse, 112; eats a lump of sugar and chews sugar cane, but will not touch food. At this hour he is brighter, swings on his ropes, and is becoming interested. Milk punch. At 2 p. m., he is again suffering from nausea, curls up on his bed, and is indifferent to all comers alike. At this hour, temperature, 38°; craves water; blood planted. 5 p. m., temperature, 38.9°; pulse, 136; about the same. 10 p. m., temperature 38.6°; pulse, 136; about the same.

May 31, 9 a. m., temperature, 37.5°; pulse, 120; seems better; eats nothing. 5 p. m., temperature, 38.2°; pulse, 128; notices occurrences in the room, but does not eat; is much emaciated and feeble. In fact, the results of his sickness are striking. Blood again planted.

June 1, 9 a. m., temperature, 37.4°; pulse, 112; is much brighter, but very weak; does not care for food. 5 p. m., temperature, 37.7°; pulse, 128.

June 2, 9 a. m., temperature, 37.7°; pulse, 112; he is better and looks better, but has no appetite; drinks coffee; is very weak and indolent.

June 5. From this time convalescence is more rapid, and on the 10th the monkey has fully recovered. Blood planted from ear tip on 29th, 30th, and 31st gives bac. icteroides, with an accidental coccus.

June 2, a companion ape—a fine, large male—was admitted to the room and insufflated the same day. Temperature, 38°. June 3, again insufflated. June 5, again insufflated. On yesterday and to-day the animal is not lively, but dull and listless, eating less than usual. June 6, he is brighter, and from this time has shown no signs of illness. Owing to his exuberant health, it was almost impossible to get temperatures, and those taken showed no indication of illness. Result, negative.

May 31, a small Brazilian monkey was introduced into the room and insufflated a number of times without appreciable effect.

Besides these animals, we have had ready reaction to the artificial infection in cats, and the organism is infectious to goats, kine, horses, and the ass (Sanarelli). Therefore, the bacillus icteroides fulfils the third postulate of Koch, and necropsies in some animals meet the further demand of the fourth—that the organism must be found generally distributed, as in the human body dead from this disease.

INFECTION BY WAY OF THE RESPIRATORY TRACT.

By an almost common consent, at least without serious denial, the theory of the convection of the morbific agent in yellow fever by the atmospheric air has prevailed. The mass of evidence in the very voluminous literature of the disease establishes this fact, and its introduction into the body with ingested food and drink has never claimed attention. As a result of their investigation, the "board of experts" appointed by Congress for the purpose of reporting upon this disease, as it prevailed in 1878 in the South, states that "Atmospheric air is the usual medium through which the infection is received into the human system."

While this unanimity of opinion has prevailed, there have been few expressions as to the probability of the lungs being the primary seat of the disease. The theories of the earlier writers that the disease was due to "noxious emanations" and "effluvia" from certain sources also conveyed the idea that such injurious agents were absorbed from the lungs; as also the later theory that some specific organism, in its evolution *outside* of the human body, produced a toxic substance which must be absorbed through the lungs, and thus give rise to the disease. All recent observers in this field have recognized the probability that the disease was due to one of the pathogenic bacteria, but the mode of its invasion has been as obscure as the organism itself. Misled by serious and somewhat constant local manifestations in the alimentary tract, the most careful attention has been paid to this locality in the effort to isolate the causative germ, to the partial exclusion of others. And it is to this fact mainly that we owe the very general failure of observers to identify the organism. As in enteric fever, we sought the local manifestation, and since this seemed greatest in the alimentary canal, this was supposed to be the seat of the primary colonization. But our later knowledge in enteric fever has changed this, and we now recognize that "Typhoid fever is[1] no more primarily intestinal than is smallpox primarily a cutaneous disease."

A number of cases recently collected by Bryant[2] demonstrate that the bacillus of Eberth gives rise to an intoxication from its colonization in the lungs, from which it may pass to the general circulation, identical with "typhoid" fever accompanied by intestinal lesions. In these pulmonary cases the intestinal canal appears practically normal, and the lungs may or may not show broncho-pneumonia.

Sanarelli calls attention to cases of yellow fever *without* the usual lesions of the digestive tract, and we too have observed these, i. e., that of Private Smith mentioned above, in which they were poorly marked. A close analogy has been always observed between yellow fever and typhoid, as many of the distinctive terms applied to the former will show, as typhus icteroides, etc., and it is remarkable that this is maintained in the characteristics of the two organisms, and in the mode of their invasion.

Commencing our observations with the knowledge that the general belief was that the intoxication in yellow fever arose from the intestinal canal, it is not remarkable that we also shared in this belief.

Sternberg[3] had declared that "it seems probable that this germinal principle of the disease is contained in the alvine discharges," of course meaning that it had developed in the canal after its introduction into the body.

A careful search, however, in a number of cases, inclined us to the belief that the b. icteroides was not usually found in this canal, and later to the conclusion that it was there found *only* as an incident to a hemorrhage into the canal.

Sanarelli[4] failed to isolate the bacillus from this canal.

Sternberg's[3] extensive work gave no result so far as the isolation of the "germinal principle" was involved.

So far, then, as the mode of invasion was concerned at that time the theory of Sternberg was paramount. For, although Sanarelli[4] succeeded in producing the disease by intratracheal injections in animals, he seems to have attached no importance to them more than to ordinary subcutaneous inoculations, and declares that "il est donc possible que la contagion du virus amarilligène puisse s'effectuer, même dans la nature, par l'intermédiaire de l'air. Cela serait d'accord avec la plupart des opinions dominantes sur ce sujet,"[4] and that the transmission of the malady, in guinea pigs and rabbits, may be obtained experimentally, "même par les voies respiratoires."[5] Indeed, he says, that by following the method of incubating large fragments of hepatic tissue, "elle m'a permis d'établir *exactement* le *siège* et la voie de *diffusion* du b. ictéroïde,"[4] in this organ. Also "en avoir signalé la présence dans le sang circulant." In other words, Sanarelli, while excluding the idea of *localization* in the intestinal canal, assumes that once introduced there results from the presence of b. icteroides an infection of the blood, a veritable septicæmia, "*une infection du sang*," for he says, in regard to the choice of the intravenous method of inoculating dogs, that one can readily comprehend it, if one remembers that "the bacillus of the yellow fever does *not live in the tissues*, but in the blood,"[1] which is also the medium of circulating the poison which it therein produces; although in another place he states that "these microbes localize themselves in the spleen, where, during the disease, they remain without multiplying to any great extent,"[2] from which they at a given time "burst forth into the general circulation, proliferate rapidly and kill by septicæmia."[3]

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[1] Osler, Principles and Practice of Medicine, p. 7; 1899.

[2] Br. Med. Jour. Apr. 1, 1899.

[3] Report on yellow fever, M. H. S., 1890.

[4] Annales de l'Institut Pasteur, June, 1897.

[5] Page 509, idem.

To this we do not assent, nor can we find in the statements of Sanarelli anything to lead to that conclusion, for the reason that from the mode of his infections there must have in all cases resulted a "veritable septicæmia," and it is not clear to us that a condition so patent can be received as proof of the theory that this disease is primarily of the circulating blood. Moreover, the mass of proof from his work shows that the disease is temporarily *local*, even in the subcutaneous inoculations of animals, for of those animals "sacrificed" to establish the period of the general infection after such inoculations, he found this to have been established only after thirty-six hours.

Writing of the method of "*infection par les voies respiratoires*," he says that it has a certain interest, because "*il reste encore* à établir quelle est en réalité la voie de pénétration du virus dans l'organisme humain,"[4] and further declares that the bacteriologic researches in such cases are most frequently negative.

Our experiences are confirmatory of the latter statement.

Also in regard to the distribution of the organism in guinea pigs after this method of inoculation, he says that the process has less the type of an ordinary general infection than of a "veritable intoxication," which admits of the construction that he considered these cases peculiar; but he calls attention to the analogies existing in these cases and those in man in which the body is found at necropsy sterile or without the presence of b. icteroides.

In our animal experiments we have shown that white mice and guinea pigs so quickly develop a septicæmia that it has been impracticable for us to assert that the disease in these animals is primarily localized in the lungs, but we have found it impossible to produce the disease in guinea pigs by feeding them the bac. icteroides, as was done with mice.

Although the mice may be classed as ingestion experiments, the constant failure to find the organism in their intestines shows that the mode of infection was not by an ingestion, and since the organism was found in their bronchial tubules, they should be classed as inhalation experiments.

Dog A was fed upon food literally soaked in bouillon culture of b. icteroides for three weeks, with not a sign of change. The culture was then placed within the intestine beyond the very acid stomach, and gave no reaction whatever.

On March 21, 1899, two young guinea pigs were placed in a glass jar and fed upon bouillon and agar growths of b. icteroides from Montevideo until April 10, with no reaction; both pigs subsequently used to test b. icteroides intraperitoneally, and succumbed.

On March 8, 1899, a young rabbit, half grown, is injected by means of a soft rubber catheter passed into the stomach, with 5 c. c. of b. icteroides in bouillon. There was no reaction, animal gave no sign of illness, and ate freely. It was kept under constant observation until the 20th, with no results.

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[1] L'œuvre médico-chirurgicale, April, 1898, p. 299.

[2] Idem, p. 296.

[3] Idem, p. 305.

[4] Annales de l'Institute Pasteur, June, 1897, p. 481.

May 4, 1899, a half-grown guinea pig was confined in a glass jar, and fed upon bread soaked in bouillon culture b. icteroides (Smith) from this date until the 25th, when, needing the jar for other use, he was returned to the cage and watched. On the 30th he was quite well.

In this connection we introduce an experiment of placing the culture in the intestine beyond its stomach.

On May 3, 1899, a pig of 550 grams was laparotomized, a loop of the small intestine drawn out, and 0.5 c. c. of b. icteroides (Smith) introduced by means of a hypodermic syringe, the puncture point being carefully sterilized upon withdrawing the needle. Done under ether. Reaction good. May 4, animal is not bright; temperature, 38.3°; eats a little. May 5, animal is quite sick; temperature, 39.4°; eats nothing. May 6, animal is quite sick; temperature, 39.8°; dies at 3 p. m.

Necropsy (*at once*).—Wound nicely healed; vessels of skin and mesentery engorged; peritoneum not inflamed; fluid opalescent; liver is somewhat yellow; spleen looks normal; lungs congested; heart full of blood; kidneys congested; the urine is albuminous; the stomach contains "black vomit;" the duodenum also; cultures from organs and fluids. The blood gave a mixed culture of icteroides in one tube (with colon) and a pure culture in another; the other organs gave it in pure culture; the peritoneal fluid was mixed b. icteroides and coli communis.

In this case we are afraid that the very delicate walls of the intestine did not tolerate the injury, and that some bacilli entered the peritoneal cavity, either at the time or later from leakage through the puncture. At any rate the pig reacted precisely as did those injected intraperitoneally.

On May 11, commenced to feed two domestic pigs, 6 weeks old, native, upon food impregnated with b. icteroides, in separate compartments of an isolated cage. On this date we gave each of them in its basin 2 c. c. bouillon culture from No. 18, New Orleans, and No. 36, New Orleans, and from Smith, or 6 c. c. in all; besides several tube cultures, on agar of the same. They devour the agar cultures with avidity.

On May 14, gave 2 c. c. bouillon culture of bac. icteroides and an agar culture to each one; they appear well. On May 18, fed them two mice dead of icteroides M[1] and N. On May 19, gave each one 250 c. c. of a twenty-four-hour bouillon culture icteroides, Montevideo. On May 22, appear well; eat heartily; again given 250 c. c. bouillon culture from No. 18, New Orleans. On May 24, fed them the organs of a guinea pig dead from b. icteroides, to which also have been given full doses of Helenina as a curative. On May 25, fed them three fine agar growths each of b. icteroides from the same pig. On May 27, fed them the organs of pig No. 30 dead of b. icteroides. On May 29, fed them each two agar tube growths and 2 c. c. each fresh bouillon culture of b. icteroides from Professor Sanarelli at Bologna, Italy. They appear quite well and fat.

On June 1, the pigs are in perfect order, three weeks from date of first exposure. On this date we injected into the peritoneum of one of them 4 c. c. of a three-day bouillon culture of b. icteroides, planted from a bulb of rabbit's blood sent us by Professor Sanarelli from Bologna and marked "very virulent."

On June 2, pig has eaten all of his food; is bright and shows no uneasiness; 5 p. m., is well and eats. On June 3, pig is quite normal; again injected into the cavity of the abdomen 5 c. c. of a twenty-four-hour bouillon culture made from the virulent blood sent us as above stated. At 5 p. m., the two pigs are alike in that everything has been eaten from their respective pans, and they cry for more. On May 4, both pigs are normal; can see no trace of illness in the injected pig.

It would appear, therefore, that the infection of yellow fever is always admitted by the respiratory tract and not by the alimentary tract. Moreover, we have shown that in rabbits and dogs, to which the infection has been conveyed by insufflating the lungs, there exists purely a local infection, without any septicæmia and that the organism can only be regained from the secretion of the lungs. In these animals the colonization is localized, the systemic invasion is of the toxins alone. As confirmatory evidence we will here introduce a number of cases which contracted the disease in our animal room, which was large, well ventilated, and kept thoroughly clean.

Rabbit S. S., pregnant female, was first noticed on the 16th of April, 1899, to be acting queerly and was isolated and given cotton wool for bedding. On the 17th she was quite wild, tearing up and remaking her bed frequently. She was found dead on the 18th at 6 a. m., having dropped six pups during the night, two alive and four dead.

Necropsy (*at 9 a. m.*).—Body kept on ice. No rigidity; eyes yellow and injected; the vulva bloody; inner surface of skin and the abdominal walls yellowish and much congested; on the left side there is a large intermuscular extravasation; vessels of the mesentery are engorged; there are a few small extravasations between the layers of the mesentery of small intestines; the peritoneal covering of the uterus is hemorrhagic; the liver is yellow-red in color; of nutmeg appearance, with plaques of yellow; spleen normal in size, congested; kidneys are congested; the left heart is contracted, the right is full of dark blood. The lungs were carefully examined, because we had lost a guinea pig sometime before from lobar pneumonia, and we feared that this had gotten among the animals; the lungs were bright red, well contracted, floated high in water bath, although there was much stasis; they felt generally crepitant to the fingers and gave no appearance of lobar pneumonia; a few lobules were atelectatic, a broncho-pneumonia; the mucosa of trachea and bronchi was covered with muco-pus, at points blood stained; there were numerous small extravasations; there was no pleurisy; the stomach wall had ruptured at its cardiac end; the bolus of food lying in the abdominal cavity was covered with a dense layer of mucus stained *black* in patches from extravasated blood; the mucosa was generally stained a deep wine color, and there were many small hemorrhages; small intestines the same; pericardial and peritoneal fluids were bloody; the uterus contained an embryo nearly at term; much clot and débris; its mucosa washed shows many extravasations; bladder contains less than one c. c. urine, which becomes solid when dropped into Esbach's solution. Culture tubes from liver, spleen, kidneys, blood, and feces.

Liver examined for fatty degeneration. Osmic acid shows the cells full of dark granules. Liver tissue dried over sulphuric acid, extracted with ether, and this evaporated left free fat, as follows: Fresh, 8.150 grams; dried, 2.675 grams; residue, 1.505 grams; fat, 1.170 grams, or 14.35 and 40 per cent.[1]

All tubes sterile after seventy-two hours except those made from tracheal and bronchial *mucus*. From these, after much trouble, we isolated b. icteroides in pure culture.

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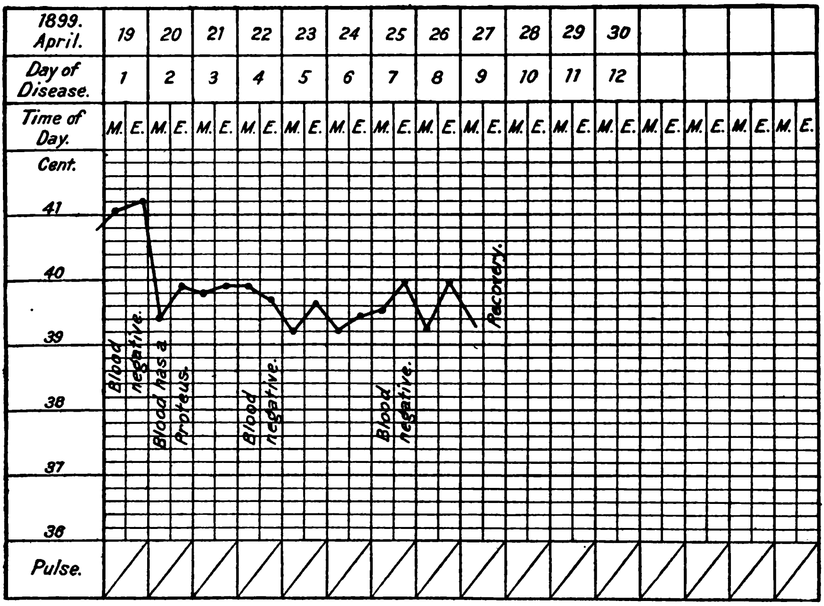
[1] Gautier gives for the fatty livers 2.5 to 17 per cent.

Necropsy was made on an embryo taken from the membranes and cultures made from blood of liver, etc., but after seventy-two hours all remained sterile. At the same time cultures were made from the body of an embryo found intra-utero, which after seventy-two hours' incubation proved sterile.

Rabbit S, a female just delivered of six pups, is noticed to be quite ill, a. m. 19th of April, neglecting her young and acting strangely; temperature, 41°; pulse and respiration very rapid; blood from ear vein planted. At 4 p. m. she is noticed picking at food, but has eaten nothing; drinks copiously; pups are nearly full term.

On 20th a. m. she is still ill; eats nothing; attends to her young but little; pulse and breathing rapid; blood from ear vein again planted; p. m., she seems quite ill. On 21st, breathing rapid; seems better; p. m., eats very little; five pups are dead—emaciated. On 22d, blood again planted.

[Rabbit S.—Disease, yellow fever.]



From the tubes first made from the blood there was obtained a proteus which liquefied gelatin on the second day—evidently a contamination accidental, since none of the other tubes were infected after seventy-two hours.

Necropsy was made on the pup which died on the 26th, and tubes planted from blood and organs, but, unfortunately, *not* from the bronchial mucus, since this was at the time not fully appreciated. After seventy-two hours there were several colonies of a colon bacillus—none of b. icteroides.

May 1, 1899, there was found dead a pup No. 1 of dog C, which pupped April 24.

Necropsy.—Dead several hours; rigidity; compound dislocation of right forearm at elbow; tissues dry; vessels full; liver congested and of a yellow color in patches. The spleen is normal; kidneys congested; lungs congested; heart in diastole; culture tubes from all organs and the blood and fluids and bronchioles.

There was, after forty-eight hours, a gross rod in the heart and peritoneal tubes, which turned orange red on agar-agar after several days. The spleen gave a pure colon growth; the liver a mixture of colon and the orange-red bacillus. The tubes from the bronchi gave freely a highly translatory rod, which proved fatal to a cat in thirty hours, with characteristic post-mortem appearances, and with the bac. icteroides in *pure* culture in the spleen of a rabbit after an intra-peritoneal injection of a bouillon culture from the cat's heart blood.

On May 17, found dead in cage, pup of dam C, born on April 24, No. 2.

Necropsy.—Body of a well-grown, fat puppy, the tissues yellowish; tongue and mouth bloody; no sign of any injury; vessels of mesentery are full; the liver is yellowish in plaques and is congested; the spleen is a little enlarged; kidneys congested; bladder had five drops *only* of urine, and this in Esbach's fluid immediately solidified; the heart in diastole; the pericardium and the pleuræ were normal, or congested; the lungs presented numerous lobules contracted in broncho-pneumonia; mucosa of trachea and large tubes ecchymotic and bathed in muco-pus. Culture tubes from heart blood, liver, spleen and kidneys, urine and fæces, also from pericardial and peritoneal fluids.

Portions of hepatic tissue, teased in 2 per cent osmic acid, showed very free degeneration of the hepatic cells, many presenting several black-stained droplets of fat. The liver gave as follows: Fresh, 4.475 grams; dried, 0.956 grams; débris, 0.662 grams; fat, 0.294 grams; or fresh, 6.35 per cent; dry, 30.75 per cent of fat extracted.

The cultures from blood and organs were sterile after seventy-two hours, except from the liver, which gave a colon. The cultures from the tracheal and bronchial mucus gave mixed cultures, from which bac. icteroides were isolated in pure culture through animals.

On May 20, found dead in cage a rabbit pup from dam No. 27, born on the 12th.

Necropsy.—A thin small animal, dead for some time; organs much decomposed; liver is almost black; the stomach walls show port-wine color and submucous extravasations; the intestinal mucosa deeply congested; spleen normal in size; bladder empty; lungs congested, bronchopneumonic, and float deep in water bath. Cultures from organs and fluids give a colon-mixed growth; no icteroides.

The necropsies of three white mice, X, XX, and XXX, are as follows:

Necropsy mouse XXX.—Dead several hours. Skin is yellowish on inner surface; vessels are distended; liver is very yellow from fatty change; spleen appears normal in size; urine is albuminous; vulva is swollen, and there escapes a bloody discharge; the uterus contains five embryos, possibly of mid term; one has been aborted. Cultures taken from organs and fluids, bronchial tubes, and from a fœtus. From the fœtus a pure colony of b. coli communis was obtained, similar to the "X" bacillus of Sternberg. The b. icteroides was not isolated from the other tubes.

Mouse X.—Found dead in general cage, May 8, 1899. Dead for some time; much decomposed; liver is a mottled yellow-red; spleen is normal to the eye; abdominal contents decomposed. Cultures from all organs and fluids and from tracheal mucus. All tubes gave the presence of a suggestively motile rod, but we were not able to isolate bac. icteroides.

Mouse XX.—Found dead in cage; the liver is distinctly fatty; spleen normal; stomach and duodenum hemorrhagic; cultures from blood, liver, spleen, and fæces. The bac. icteroides isolated in pure culture from blood and organs but not from fæces.

On May 25 a large pregnant guinea pig was noticed to be droopy and not eating; this was attributed to her condition; on the 26th and 27th she ate a little soaked bread, but was very quiet. On the 28th she brightened up, but died at 3 p. m. of 29th. Temperature 36.5°, or in collapse.

Necropsy (*at once*).—Body of a fine large pig; nose and lips bluish; black bloody discharge just commences from vulva; skin vessels full and there is slight icterus of inner surface of the pelt; the uterine walls are dark red; the bladder contains 3–5 drops urine that proves albuminous in Esbach's fluid; vessels of mesentery full; liver is dark from congestion, but the thin edges are yellowish; gall bladder full; spleen much enlarged and friable; kidneys swollen; right heart distended; pericardium and pleuræ ecchymotic; the lungs generally congested; the middle right lobe is *lobularly* pneumonic, as also the lower left lobe; bronchial mucosa inflamed; the stomach contains undigested food; the mucosa is very slightly congested; that of the small intestine also, which contains much bloody mucus; cultures from all sources—from mother and from amniotic fluid and from pups, of which there are six in utero.

Liver tissue teased in osmic acid gives no appreciable fatty change, unless a few minute dark granules mark the commencement of this change in the albuminoids of the cell. From the cultures of the amniotic fluid and the embryos there were pure cultures of a primarily translatory bacillus, which resembled bac. "X" in all respects, even to the subsequent loss of its motility. The liver gave a colon; the others were sterile, except those from the bronchial mucus, which undoubtedly contained an organism resembling icteroides in mixed culture, but we were unable to obtain it pure.

In this connection we must call attention to the fact that in our animal room, which was large, well lighted and well ventilated, and well cared for, there had been but *one natural death* among our animals, which were kept in galvanized wire cages, from December 1, 1898, to April 7, 1899. This one death was caused from the pneumococcus, isolated post mortem from lobar consolidation, during February.

On April 7, 1899, we made our *first* insufflation in the room adjoining and connecting with the animal room. We were as circumspect as possible in insufflating the dog A, and did not anticipate any casualties among the animals. This was done on the 7th, the germ being evidently borne by the air into this room, for rabbit SS died during the night of the 17th, or just ten days from this *air-born exposure* (although animals had been *injected freely* and had died in this room for several months). If three days are given in which to have caught the infection, the balance of seven days is just the cyclic period of this disease in this animal, as it is in guinea pigs inoculated with minute doses of the bacillus, *thus* avoiding a primarily fatal intoxication from preexisting toxins; and as in dog A, in white mice, and in the monkey. From this animal's bronchial tubes was regained the bacillus icteroides, never found by us save in those sick or dead from clinical yellow fever. This animal gave 40 per cent of *fat* in the dried liver, and 14.3 per cent of the entire weight of the fresh liver.

Coincidently, another female rabbit, S, under like conditions becomes very ill, does not care for her young (*all* of which finally die), but recovers in seven days, or on the 26th, having fallen ill on the 19th.

Again, mouse XXX is found in miscarriage and dies with five pups in utero.

A large guinea pig dies just before miscarriage, which seemed imminent, in five days from first observation. In these *nine* cases the specific agent of infection, the b. icteroides, was found in rabbit SS, mouse XX, and from two puppies, or four of the nine. Further, in three of these it was isolated from the bronchial mucus, *all other tubes remaining sterile*, the mouse alone showing septicæmia.

Moreover, rabbit S should be eliminated from the contrary cases, because she *recovered*, and since there is *never a septicæmia* in these animals (see No. 15 and No. 25), we, of course, could not obtain the bronchial mucus from which to attempt the isolation of the bacillus. This elimination made, we will have a result of 50 per cent of isolations of the bacillus from these cases, or nearly as good as that of Professor Sanarelli in his series of cases of yellow fever.

Since these facts establish the mode of entrance and the seat of the primary disease, the changes which take place in the lungs become a matter of great interest. Many of the earlier authors, as collected by La Roche,[1] make little mention of clinical features that could have been attributed to these organs, yet many of them describe "an embarrassment of the respiratory act," a "laborious respiration," a "sense of inability to expand the chest and inflate the lungs," none of these symptoms being considered "*constant* attendants," and Rush gives among premonitory signs of the disease "a dull pain in the side" (chest), or "a hoarseness or slight sore throat." Hemorrhage sometimes takes place from the lung. Since our attention has been called to this point we have had access to four undoubted cases of yellow fever, namely, Everette, Sesein, Quintela Macias, and Rodriguez, and in three there was clinical evidence of lung trouble, such as râles, some pain, and hemoptysis; in one, Everette, this was an alarming symptom; in one, Kauna Sesein, there was no respiratory difficulty. In our personal experience we can recall other cases in which there was broncho pneumonia. In necropsy work the lungs have been relegated to an undeserved obscurity, but nothing is more frequent than to find these organs the seat of an extensive broncho-pneumonia, or a condition resembling closely the "grippe lung," in which the principal change is that of the loss of elasticity in the frame work, due indirectly to the influence of the toxin, which primarily affects the vasomotor control of the larger blood vessels, the stasis in the capillaries that results still further influencing the elastic frame work of the alveoli, which is their sole support. The influence of the b. icteroides thus localized is then similar to that of the Pfeiffer bacillus in that they do not, as the pneumo-bacillus, give rise to a complete inflammation, or the congregation of leucocytes and formation of a fibrinous deposit. There is less local change in the invasion of yellow fever than in grippe. And the experimental work in animals shows this, that the local influences of the injected organism, b. icteroides, are very slight. Peritonitis or other serous inflammation is the rare exception, and in the connective tissues there is but little change other than the intense congestion, which is general. The toxic influence upon the tissue of the lung explains, even in the absence of cough and pain, that feeling of pulmonary insufficiency described by La Roche, as well as that omnipresent symptom, which is universally recognized, the dusky, bluish condition of the skin, due to congestion of the vessels and diminished aëration of the blood. In the blood itself there seems remarkably little change in the elements, for in a number of cases in which we counted the cell elements these seemed normal, save for the reduction of the hemoglobin. We believe, therefore, that it is from the absence of *special* local reactions in the lungs that we have been led to misinterpret their importance in this disease, and it is a matter of regret that we did not realize this fact at an earlier date.

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[1] On yellow fever, vol. 1, p. 132.

From three cases—those of Kauna Sesein, Quintela Macias, and Rodriguez—we examined the sputum most carefully, with the result that the b. icteroides was isolated from one—K. Sesein. In the two others it was not isolated pure. However, we are informed by Dr. Meacham that he isolated "from the lung" of Q. Macias a bacillus which he thought to be icteroides.

The isolation of this rod from the sputum promises to be most difficult, as we have found the sputum rich in micro-organisms, many of them of the colon group, and in one case—Quintela Macias—the "X" bacillus was obtained in pure culture and in beautiful activity. We were led to the plan of adding a little bouillon to the sputum, triturating it, and placing for twenty-four hours in the ice chamber, the motile organisms responding quickly, others more slowly at 18°, plates from this mixture giving an absence of many of the ordinary germs of the air encountered otherwise. The sputum, therefore, is of a diagnostic value, and this will be the greater in those cases of the disease in which there may be no secondary invasion of the blood, but in all before this invasion takes place.

SECONDARY INVASION.

The primary reaction in yellow fever, lasting from "three to five days" as the rule, is followed by a more or less distinct remission of temperature, subsidence of all other symptoms, and an apparent improvement of the patient, either to be continued into convalescence or, after a "period of calm," to give place to another rise of temperature and a notable aggravation of all symptoms. This latter access of the disease is generally known as the "reactionary fever," or, as Bancroft termed it, "the second paroxysm."

It is one of the most prominent of the clinical features of this disease, and among clinicians of endemic or epidemic centers it is considered of the greatest assistance in formulating an opinion. So true is this that the most experienced of these clinicians prefer to defer an opinion until there is no longer doubt as to its occurrence. From our earliest professional recollection, in a possible epidemic area, the most intense interest has centered around this "second paroxysm," and we have heard from the lips of many the expression of an utter noncomprehension of this clinical phenomenon, which embraces the period of calm or cessation of fever. This characteristic clinical peculiarity of yellow fever, stated by La Roche[1] to be "of itself almost sufficient to enable us to diagnose the case," occurs in perhaps a majority of all cases, the same author describing its absence in those cases of a mild type "in which symptoms of the first stage alone are noticed," or "in the violent and congestive forms of the disease," which terminate before these later symptoms develop. This corresponds with the classification adopted by Sternberg,[2] of "mild yellow fever," "grave yellow fever," and "yellow fever siderante," there being numbers of cases merging from the first into the second. The third variety is distinct, fulminant, foudroyante, fatal.

We have isolated the cause of this infection, and have, we trust, shown its natural pathogenicity to animals and the mode of its invasion. We believe that there is sufficient anatomic and bacteriologic evidence to warrant these opinions, and we ask that in this matter, which has exercised so many observers who have preceded us, that the errors of judgment which may be expressed be attributed only to that one of us[1] who has had in control all experiments relating to natural infection, invasion, and allied subjects. There is no adequate explanation advanced to account for these clinical facts, as they have been accepted for years. The studies in histo-pathology have resulted in no elucidation of them.

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[1] La Roche on yellow fever, vol. 1, p. 428.

[2] Report on Y. F., 1890., Treas. Dept.; Document 1328, Marine-Hospital Service.

These facts, in a moderately severe case terminating in recovery, as in the second class of cases, are a distinct access of temperature, reaching the maximum early in the disease, followed by a no less distinct fall to the normal or below it; this in turn followed by a quiescent stage, to be succeeded by a condition more aggravated than the first stage, and in which increase of temperature, remittent or intermittent, may or may not be a feature. The time occupied by the first stage may be from two to five days, or longer; that of the second may be from a few hours to one or two days; that of the third is very irregular and may be terminated by death in one day, or extend into a tardy convalescence. Although pathologically we have no explanation, we believe that there is an explanation to be based upon bacteriologic data.

The first stage is the result of the colonization of the bac. icteroides, the intoxication producing the rise of temperature and other symptoms; this lasts from two to five days. During this time, our experience has been, the blood is free from the organism for the first day or two; in other words, it is strictly localized in the pulmonary tissues, and is found in quantity in the blood only after several days.

The first invasion in the pulmonary tissue followed by its intoxication soon gives place to an improvement, which frequently, and in some epidemics almost invariably, is the commencement of convalescence. During the earlier part of this time the blood is sterile, but its contamination takes place about this time, from the second to the fifth day, after which all symptoms become aggravated—by *what? By the secondary invasion of the blood by the b. icteroides from the lungs, the primary seat of the colonization.* This corresponds with the known incubative period of the disease, for, if the changes in the pulmonary tissue, dependent upon the first colonization, allow the entrance of the germ into the general circulation upon the first or second day of the disease, the minimum period of incubation of the organism in the blood (formation of the second colony) would not permit it to be perceived until the second, or third to the fifth day, thus giving a clinical picture of an access of temperature (after three days' incubation in the lungs) for from two to five days, then a depression of one to two, to be closed by an irregular condition of fever, from septicæmia.

The thermo-charts of our animal cases give no pictures of this more or less abrupt decline in the temperature; their fevers are typically of *one* paroxysm, because in them there was no subsequent complicating invasion of their blood.

The exception to this statement was in the instance of the disease in the ape, in whose blood the germ was found after the third day. We do not believe that this perfect picture is frequently seen at the bedside, and this has been observed by others, for there exists the "impossibility to establish in yellow fever a '*type thermique specifique*.'"[2] And this irregular expression of this well-established fact is due to irregularities of incubation and secondary invasion, in turn due to less virulence of the microorganism, or greater resistance of the individual attacked. We assert that this is reasonable, for this secondary invasion or "third stage," or "second paroxysm," is quite as *specific* as the primary or first paroxysm; therefore, it must depend on equally as specific a cause, and we see the analogy between this increase of severity of the symptoms of this secondary invasion of the germ into the blood and the well-known severity of symptoms which follow the *intravenous* injection of the virulent culture into the horse during the process of antitoxin production, although the animal has been prepared for this septicæmia by preceding intoxication with filtered cultures or toxins. We therefore submit that the disease is one of two paroxysms whenever there results from the first colonization in the lungs a second one in the blood—a septicæmia.

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[1] Wasdin.

[2] Sanarelli.

In the mild cases yellow fever is purely local and of one simple paroxysm, due to an amount of intoxication against which the system readily contends. The rare *siderante* cases are those in which the virulence of the organism plus a lessened individual resistance results in the production of an intoxication quickly fatal. In these cases there either is not a blood invasion or a too limited time for an incubation sufficient to assist in the fatal result. This corresponds with our bacteriologic results obtained post-mortem. Case No. 11 was of this kind, ending fatally in fifty-three hours, in which the blood was almost destitute of bac. icteroides, and Sanarelli refers to these cases "where the cadaver is almost sterile, and where the quantity of urea contained in the blood is very high," or "where the cadaver gives cultures almost pure of other microbes than the specific one," in which "one may attribute death to a septicæmia" secondary in the course of the disease.

In these fulminant cases whatever the increase of urea in the blood this depends upon the changes induced in the liver by the toxin, and is only a contributory cause of death. In those developing a colon, or other septicæmia, even in pure type we question the absence of the specific organism, and we do this upon the basis of our larger percentage of isolations of the organism than that of Sanarelli. Moreover, his assertion of the antagonism existing between bac. icteroides and b. coli communis and the streptococci is not sufficient to account for their absence from the cadaver or living blood. Our experiments with the toxins will show that this position was not well taken, for the only toxin at all fatal to bac. icteroides was that of its own production. This fact might explain the absence of the bacillus from some dead bodies, as in the siderante cases, in which there must be an intense intoxication, or their presence in very small numbers, but it would also then apply to all dead bodies, in many of which, however, we find the organism.

How much influence the presence in the blood of b. coli communis, b. proteus, or the micrococci may exercise upon the termination of a case we are not prepared to assume, but we have no doubt that these auto-infections add materially to the mortality of the disease, although our experience leads us to believe that they do but little harm in comparison to the more potent organism, b. icteroides, and that this harm will depend upon the presence principally of one of the more virulent forms of bac. coli communis, whether it enters the blood with b. icteroides from the lung or during the "last hours of life" from the changed intestinal tract. We can not accept the theory of Sanarelli that these facts are to be explained by the "location" of the bacillus in the spleen after its entrance into the body, its keeping dark "during the entire course of the malady," and finally, at a given time, bursting out upon the blood, invading the whole body. In lieu of this most unsatisfactory explanation we offer the above solution of the vexed problem of yellow fever.

THE DISEASE IS NOT PRIMARILY A SEPTICÆMIA.

The admiration which we naturally felt for one so learned and heroic as Professor Sanarelli at the commencement of our investigation has, during its continuance, but given place to a greater one, and we must acknowledge the greatest amount of assistance from his published memoirs, as well as the most lively appreciation of his written expressions of regard for us, and his helpful suggestions to us. Therefore it is with a feeling of the greatest reluctance that we differ from him in these minor matters. Still from a therapeutic point of view it is a matter of much importance that we should know the seat of the specific agent in these infections, in order to attempt to combat them locally, thus limiting their toxin production. In many cases nature does this effectually, the disease being limited to an ephemera, or as McFarland, of New Orleans, phrased it, "resembles nothing *more* than a violent cold." Such cases are the most usual in children, giving rise to the expression by Guiteras that yellow fever is one of the most innocuous diseases of childhood. Why this should be so we do not comprehend, yet we know that the physiologic processes in children, the tissue metabolisms, are very active, and perhaps these are sufficient, on the invasion of the lungs by bac. icteroides, to limit the colonization to that locality, and to prohibit a septicæmia. Clinically, too, we would expect graver symptoms, and more frequently fatal results, were these cases septicæmia produced by so virulent an organism. Rabbits seem to possess in a great measure this power of keeping the germ localized, for only in number 15 did we find an invasion of other tissues, and in this case there was no septicæmia. Dogs possess this localizing power to a perfect degree, and this is in accord with the discovery of Nuttall of the germicidal influence of their blood serum, a fact demonstrated by the difficulty with which Sanarelli and others have produced a septicæmia, by intravenous injection, sufficient to kill, and the evidence of a diminution of the numbers of the bacilli which followed these injections.

In monkeys there seems to be a lack of this controlling power, for in our single, but perfectly marked infection, the organism invaded the blood as in man.

The question naturally arises here as to the frequency of the exercise of this controlling influence in adults; as to how many proportionately are "mild cases," and how many of the class characterized by this "second paroxysm," or secondary invasion, or septicæmia? Children native to endemic localities have long been thought immune to the disease; so also, for many years in the South, the negro race; also, there has existed the custom among "yellow fever experts" to search health records for data immediately preceding an outbreak, from which to form an opinion as to the time of its inception, and the person with whom it commenced. All of which goes to show that there has never existed any perfection in diagnosis, and we do not believe that any symptoms in these very mild cases will lead us to their diagnosis with unerring certainty. We have found the bac. icteroides in the sputum of but one case of three examined for it. In one of the others it was said to have been found by another observer.

In 50 per cent of animals naturally infected, or without our intervention, it was found in the secretion from the bronchi, and in all of those into which it was insufflated. Therefore, an early examination of this secretion may result in an early diagnosis of the disease. Just here we would allude to the very remarkable degree of infectiveness of b.

icteroides, and to suggest that were these cases septicæmiæ, in which the germ is locked within the fastnesses of the spleen and in the circulating blood, they would be innocuous until they became of such severity that breakage of capillaries would result in hemorrhage, either into the lungs, intestine, or kidneys, through which the germ would again be in position to invade other persons. This is not the case. A mild case may prove as dangerous to others as a severe one, by infecting the domicile, and unless hemorrhage frees the bacillus from its septicæmic environment it must gain access to the domicile, to the environment, through some other medium. We believe this to be the sputum, or secretion of bronchial mucus bearing a portion of the lung colony.

Expectoration is with difficulty controlled in the most perfectly regulated sick room, and especial care would be required to insure cleanliness. Such contamination would prove innocuous until such time as the bacilli would be liberated by the desiccation and disintegration of the particles of sputum. Thereafter this would depend upon the opportunity of the germ to invade the lung of one susceptible to its influence.

This period has been termed the period of "extrinsic incubation," and has been thought to cover that time taken by the germ to undergo some occult change, dependent upon we do not know what, but by which it, having been reduced in some way in power, again becomes sufficiently virulent to give rise to the disease. This period has been variously stated at from five to ten days, and some observations seem to fix it at fourteen days. While we do not understand the nature of the causes which result in the pseudobacilli among the pathogens, we know that some organisms are reduced in virility by their passage through certain animals, and it may be possible that this is the case in man infected with b. icteroides, and that the germ requires a growth under such extrinsic conditions to regain its virulence. Still this does not apply to the organism taken artificially from the blood or organs and planted on the various culture media, for under these circumstances it is most virulent, and we have never seen the pseudobacillus icteroides. Moreover, the human inoculations of Professor Sanarelli were done with sterilized cultures of the organism which had been taken from the dead body, and these demonstrated the virulence of the toxin produced by their growth.

To us, therefore, it seems that this theory of extrinsic incubation had best give place to a safer one, as follows:

That the time necessary for an apartment, or domicile, to become dangerous to others after the entrance into it of one ill with yellow fever depends upon the facility with which the apartment, or domicile, becomes contaminated with the bronchial secretion of the patient and the rapidity with which this contaminating material may dry, become disintegrated by sweeping, dusting, etc., and floating in the air, may enter the respiratory tract of one entering the premises.

We have already alluded to the statement of Professor Sanarelli, that there are three classes of necropsy cases of yellow fever. The first presenting numbers of the specific organism present in blood and tissues; the second when they are not present, but in their place other contaminating germs; and third, cases that are sterile as to the blood and most of the tissues. Therefore, in a large proportion of his cases he assents to the absence of a specific septicæmia, or in 46 per cent of those he examined. One of us (Dr. Geddings) isolated b. icteroides from the necropsy cases from New Orleans, in 83.3 per cent of the cases, still we do not believe an even per cent would prove more than that the cases were septicæmic at death.

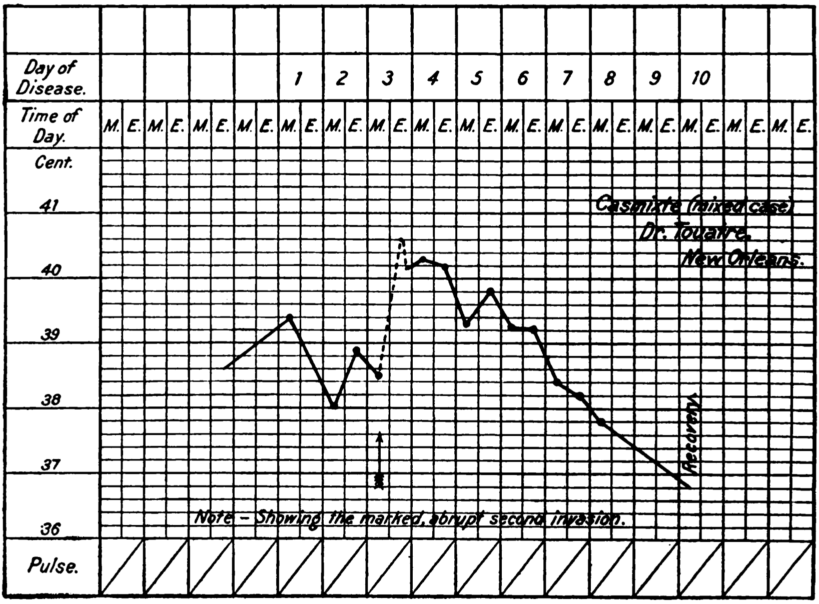
Also Sanarelli found in some of these cases the germ in the living blood, but his work did not result in so many positive isolations from this tissue as our own, yet these can only prove the septicæmia at the time the bleedings were made.

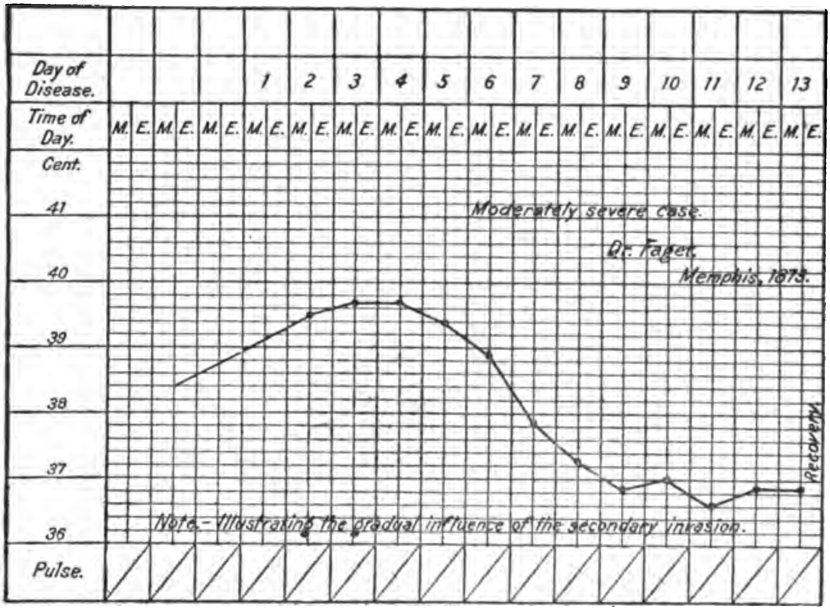
Therefore, while we realize the possible analogy between the accumulation of the malarial plasmodium in the spleen and the deeper structures, at times being entirely absent from the surface circulation, as well as the temporary retirement of the embryos of the filariæ from the superficial vessels, and the conduct of seclusion, advanced by Professor Sanarelli, in explanation of the absence of the specific organism in the circulation and its retirement to the spleen, we can not assent to it, and refer to the explanation given above.

We introduce three thermo-charts illustrating the temperature tracing in the three classes of cases diagnosed by those eminent clinicians, Drs. Faget and Touartre, of New Orleans, La. (The "notes" are our own.)

These are taken from the former's "Monographie sur le type et la spécificité de la fievre jaune," 1875, in which, besides establishing his well-known law of the noncorrelation of pulse and temperature in this disease, he furnishes much valuable information.

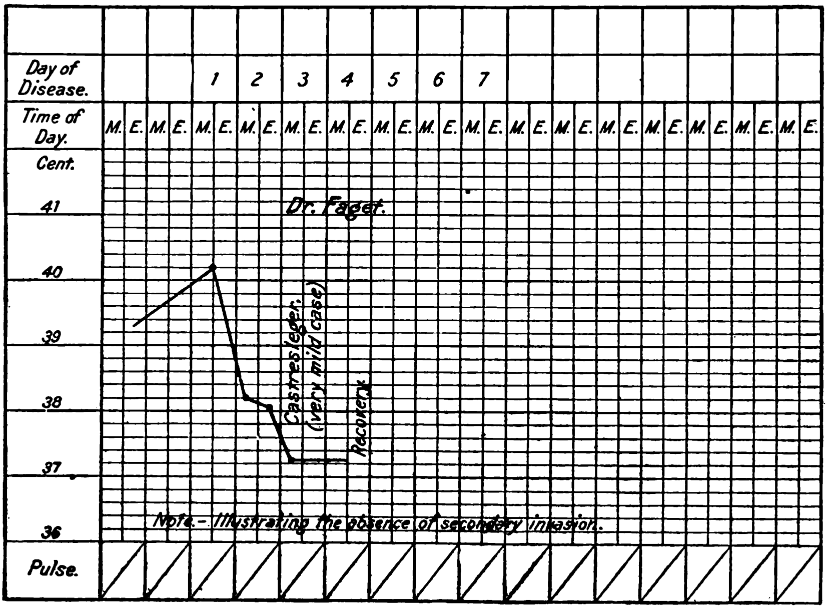
Among other points he insists upon the *difference* between the *period* of *defervescence* in yellow fever and that of other acute infections, such as pneumonia and smallpox, determining that it is *specifically so;* that is, that it depends upon the specific cause of the disease. Some of his charts also show that the secondary invasion, then as now, may end in fatal intoxication without appreciable rise of temperature, death taking place in an algid state.





Moderately severe case.
Dr. Faget.
Memphis, 1873.

Note.- Illustrating the gradual influence of the secondary invasion.



Dr. Faget.

Castresleger.
(very mild case)

Note.- Illustrating the absence of secondary invasion.

THE PRESENCE OF THE ORGANISM IN THE ALIMENTARY CANAL.

"Finally we remark that many facts relating to the origin and extension of yellow fever epidemics give support to the inference that the specific infectious agent is present in the dejecta of those suffering from the disease, and that accumulations of fecal matter and of other organic material of animal origin furnish a suitable nidus for the development of the germ when climatic conditions are favorable for its growth.

There is no evidence that yellow fever is propagated by contamination of the supply of drinking water, as frequently and probably usually occurs in the case of typhoid fever and cholera. Moreover, epidemics extend in a more deliberate manner and are restricted within a more definite area than is the case with cholera and typhoid fever. It is usually at least ten days or two weeks after the arrival of a vessel with the disease on board before the cases of local origin occur, and these cases occur in the immediate vicinity of the imported case or vessel carrying the contagion. When the disease has effected a lodgment, the area of infection extends slowly and "usually has well-defined boundaries. In towns and cities having a common water supply one portion remains healthy, while another, usually the most filthy, may be decimated by the scourge. The experimental evidence recorded and the facts just stated seem to justify the recommendation that the dejecta of yellow fever patients should be regarded as infectious material, and that such material should never be thrown into the privy-vaults or upon the soil until it has been disinfected. At all events, I think it would be very unfortunate if, upon the strength of Sanarelli's negative researches, sanitarians should neglect to disinfect the *excreta* of yellow-fever patients."

We quote these remarks from the address of Dr. Sternberg before the American Public Health Association at its meeting in 1897, to define his position in regard to the seat of the colonization of this infectious organism. As before remarked, bacteriologists have been accustomed to seek the cause at the seat of effect, and in many of our known infections this has been sufficient, the "false membrane" yielding the bac. diphtheriæ, and further search is unavailing; but if the local reaction in diphtheria was less pronounced and the seat of it less prominent we can not say that the bacillus would have even now been isolated. In other words, its prominent seat contributed to the bacteriologic result. Not so, however, in yellow fever, for although this experienced observer carefully examined some forty-three dead bodies, paying more than especial attention to the alimentary tract, in which seemed the greatest damage from the disease, he failed to find any organism possessing more than pathogenic influence upon man or animals when injected into their tissues, most frequently their blood.

There is no recorded experiment, either of Sternberg or Sanarelli, showing that they realized that the organism which they claimed or supposed might be the cause of yellow fever must be demonstrated as producing the disease *under natural conditions;* that no *artificial infection* should be taken to prove a natural fact.

A realization of the importance of establishing a natural infection with b. icteroides would have induced Professor Sanarelli to have insufflated his human subjects in lieu of intoxicating them through the veins, for, as expressed by Novy, "we know nothing about the results in man following intravenous injections of the filtered products of even the most common bacteria. What would be the results in man following intravenous injections of micrococcus prodigiosus, colon bacillus, Eberth bacillus, etc.? In all probability such injections would bring about very serious results, especially in previously diseased individuals." One natural infection in one of his insane subjects would have been far more convincing than a thousand intoxications, or artificial infections.

Bacillus "X" was constantly found in the alimentary canal of animals and man, both sick and well. But the bac. icteroides was not present in the canal of animals or man ill with yellow fever unless in the presence of a hemorrhage into the canal; and in one case with *bloody* urine, we isolated the organism from this secretion. Both bac. "X" and bac. icteroides were isolated from the sputum. Our work in the isolation of the bacillus icteroides indicates plainly that the bac. icteroides does not primarily colonize and produce its toxin in the alimentary canal, and if the bacillus is found therein it is incidental to hemorrhage. Still we would reiterate the warning of Dr. Sternberg that sanitarians should not relax their efforts to accomplish the disinfection of the dejecta from yellow-fever patients, since these hemorrhages, though very minute, are prone to occur in even moderate cases of the disease. In regard to the etiologic relation of the bacillus "X" to yellow fever, we must state, that although fully convinced of its position in the group of colon organisms by our association with it in New Orleans in 1897, we did not deem it our province to discard it from the list of possible etiologic factors until we had subjected it to the test of natural infection stated above. It has proved in our hands the most virulent colon when introduced into animals artificially, giving rise to anatomic changes very similar to those of b. icteroides. As to the cyclic period of the disease in animals under artificial conditions we must acknowledge that both b. icteroides and bac. "X" seem to exercise an influence proportionate to the amount of material injected, the fatal termination ensuing in twenty-four hours, or at the end of six to eight days. In other words, no determination as to a cyclic period can be based upon the published artificial experimental work. We therefore believe that the normal denizens of the alimentary canal have no place among the primary factors of yellow fever, however much changes in its vessels and mucosæ may exercise us in the progress of the disease.

BACILLUS ICTEROIDES NOT FOUND ASSOCIATED WITH OTHER DISEASES.

The first postulate of Koch would be unnecessarily amended if we should still further demand that the organism found constantly associated with a specific disease should not be found associated with any other specific disease in frequent instances, either prior to or after death. Ordinarily this would scarcely be considered necessary, yet in the disease in question the claim advanced by Dr. George M. Sternberg[1] that the bacillus "X," isolated from cadavers by him in Havana, Cuba, in 1889, and at that time suggested as the possible cause of yellow fever, is identical with the Sanarelli germ, and that his bacillus should receive equal recognition, has made it incumbent upon us to carefully observe whether bac. "X" is usually associated with b. icteroides in yellow fever, as well as whether it or b. icteroides is usually found associated with other diseases.

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[1] Journal Am. Pub. Health Assn., October, 1898.

To this end a number of cases of disease other than yellow fever were examined bacteriologically.

No. 1.—On December 21, 1898, we saw at the Quinta del Rey a Norwegian seaman in whose case there seemed some doubt of diagnosis. History of malarial exposure and of an irregular type of fever for four weeks. When seen there was no evidence of yellow fever, and from the condition and history we thought it malarial cachexia. Careful search was not made for the plasmodium malariæ. Blood planted in bouillon; after forty-eight hours' incubation there was no growth upon the tubes, all remained sterile. Man died later; no necropsy.

No. 2.—Blood taken from the ear tip of a case of malarial cachexia, with peri-hepatic abscess, gave no growths after forty-eight hours' incubation. Pus from abscess gave b. proteus fluorescens. On December 23 we saw, in courtesy, a young girl moribund from what is here called "la fiebre de borras," and which is alone diagnosed among the native infantile population, but at times young adults, as in this case, are attacked. We were told by her attendants that she had suffered from light malarial attacks for some time, but that this pronounced attack had occurred five days before we saw her, with chill and high fever; much pain in head and limbs; nausea and vomiting, this last having been a constant and distressing symptom. There was no temperature record, but the statement that it had risen to 40° was made. On the second day there was scantiness of urine, which continued during third, but on fourth this secretion was increased, and now there was sufficient limpid or brown urine with no albumen.

Status presens: Facies dull; eyes suffused and staring, pupils dilated; gums normal in appearance; tongue pointed and red at edges; much facial subsultus, and of the tendons of the forearms; skin of face deeply congested, and that of the chest and arms; the room was darkened, and we could see no yellow tint; mentality much impaired; died seven hours later; blood plantings gave a b. coli communis and a tetrad from the skin.

A native child, with the history of having been removed to the United States during the "insurrection," or for two years, was returned to Havana in January of 1899, and after two months, or March 5, was taken ill with continued fever of peculiar type. The diagnosis of yellow fever was first made, and the fever running a too lengthened course, the blood was examined and the malarial parasite was found.

The fever occurred in distinct paroxysms with remissions. During the febrile rise there was albuminuria with much hemoglobine, the secretion being almost black. This passed off with the fever, and during the remission the albumen was barely a trace and the urine clearer. This was repeated each day, the hemoglobinuria appearing as the febrile accompaniment of the forenoon. When we were asked to see the child all suspicion of either yellow fever or of borras fever had passed away, but blood was planted, as usual, and from it a b. coli communis and a b. proteus vulgaris were isolated. Boy recovered.

No. 5.—Diego Lazaro, 39 years of age, from Spain; nine years in Cuba, most of the time in the interior; entered the city in December, 1898, and was engaged in work upon the city sewers when taken ill in March with a sharp chill, followed by high fever, much pain in head and constant nausea; this had continued for two days when he was seen, through courtesy.

Status presens: Facies anxious; eyes and skin a little yellowish; little congestion of skin; much cough and pain in chest, the expectoration bloody; liver and spleen enlarged and tender; stomach tender; urine contains 20 per cent moist albumen. Blood examined for malarial organisms without finding them. There was a most marked change in the cellular elements, there being many gigantoblasts, as well as microcytes; the normoblasts were markedly deformed; dumb-bell shapes and other most irregular forms were seen, a true poikilocytosis; the multinuclear leucocytes were in excess, but not so much so as to indicate lobar pneumonia. Blood taken and cultures gave only a proteus bacillus. He recovered.

No. 6.—John Tabor, of Santo Domingo, aged 47, has had gastro-intestinal troubles for the past five years.

Status presens: Skin is pale and muddy and dry; abdomen swollen and tympanitic with thin walls; intestine irritable; there is borborygmus; at times violent diarrhea is followed by bloody stools. Emaciation is progressive; appetite poor; tongue dry and devoid of epithelium. Culture tubes, inoculated with blood from the ear tip, remained, after four days, sterile.

No. 7.—Fulgencia Ramos, aged 20 years, a native of Havana, has been sick one and one-half years. His illness commenced with a malarial attack, was followed by chronic diarrhea, and he is tuberculous. There are frequent and severe attacks of diarrhea, profuse night sweats, and hectic fever. Blood taken from ear tip in bulbs and sown on tubes of agar and bouillon remains permanently sterile.

No. 8.—Saturnino Ripa, from Spain, about 45 years old, has been sick one year. Has always drunk to excess; has suffered from atonic dyspepsia, and attacks of "bilious diarrhea," which is now constant and painful. There is œdema of feet and legs and hands; had yellow fever eighteen years ago, just after arriving from Spain. Ear-tip blood proved sterile on all media.

These cases, though few in number, were representative of the diseases prevalent in Havana, and if bac. icteroides be considered an element of "secondary infection" in yellow fever, it is peculiar that it was not encountered in some of these cases.

Also for the same purpose there were made a number of necropsies upon bodies dead of the diseases incident to Havana, equal or in excess of the cases of yellow fever examined for the presence of b. icteroides, and cultures prepared from all the fluids and organs of the body, with the result that in not a single case thus examined was there found an organism even remotely resembling the b. icteroides, the nearest being that isolated from necropsy No. 6, which proved a pseudo-typhoid organism, producing no fermentation in sugars, no indol, no acid reaction, and failing in pathogenicity in animals. It is unnecessary to inform you that this control necropsy work was done with the same care and vigor as that of the isolation of the bacillus in cases of diagnosed yellow fever, for you will recall the skepticism as to the specificity of the b. icteroides with which the one of us, to do this portion of the work, returned to Havana at the close of the Spanish-American war and resumed the investigation.

Section was made some thirty times in these cases, many of them at the city morgue, upon unknown and undiagnosed conditions. In all cases section was made carefully and the cultures made from the heart and liver and spleen and kidneys, and in many instances from the bile and urine and feces, directly upon slanted agar and into bouillon. Our experience had been in New Orleans that the practice of incubating portions of the organs gave less satisfactory results than the plantings at the necropsy table and was abandoned. From these cases we carefully plated all cultures giving the slightest indication of the presence of bacilli comparable to b. icteroides.

The organisms found were in great variety, the b. coli communis in many forms being the most frequent and evenly distributed among the organs, an evidence of invasion during the last hours of life; bac. proteus vulgaris was the next most frequently found; then bac. pyocyaneous; staphylococcus, and least frequently (in one case) a streptococcus. In no case was an organism isolated corresponding to that of Sanarelli.

No. 6.—Necropsy held at the hospital "Alphonso Trece," February 22, 1899. Manuel Fajada Dominguez, aged 23; history of malaria. Body of adult male; marked rigor; dead eight hours; much hypostasis about the dependent portions of trunk; skin yellow in hue; pupils dilated; eyes yellow; section showed engorged mesentery; a bronze-yellow liver, much congested; enlarged, nearly diffluent spleen; kidneys normal; stomach content free from blood; mucosa clear; that of duodenum the same; bladder contains a little urine, slightly albuminous antemortem.

Cultures from blood, organs, and fluids. After forty-eight hours all tubes from blood and spleen show a mixture of motile and immotile rods, easily plated out as coli communis, and proteus viridens, and one b. violaceus.

On the 26th of February we found on a tube from the liver a slowly growing colony of a translatory rod, which was carefully studied, with the following characteristics:

Morphology; a rounded rod; 1—1.5 × .5 μ; staining readily, but not by Gram. Actively motile, with a defined steady movement. Grows well on all media at 37°. On agar the young colonies resemble those of b. typhosus, the older growth being clear and transparent, slightly iridescent by oblique illumination.

In gelatine the young colonies are like particles of broken glass, clear and transparent, frequently nucleated, finely granular, and faintly iridescent. Surface expansions are whitish and even, with sharp borders. No liquefaction. There is no surface growth in bouillon; litmus milk remains blue and does not coagulate. In Dunham's solution, after forty-eight hours, there is no appearance of color after the addition of nitrite and acid. In lactose bouillon, 2 per cent, after forty-eight hours, no gas formation; glucose bouillon, 2 per cent, after forty-eight hours, no gas formation. The growth is generally diffused throughout the media, reaction neutral.

On potato there is an indifferent growth, which has slight brownish tint. At first this organism was suspected of being b. icteroides; hence its failure to ferment glucose was in accord with the reaction of the latter in this medium subjected to too great a heat in its preparation. Later this was corrected, and the organism found to have a neutral reaction in glucose and lactose media. Some nine months later, or in December of the same year, the organism introduced into animals in full doses, 2 to 10 c. c. bouillon culture, gave rise to no reaction. It was considered a pseudo-typhoid bacillus.

The most frequently isolated form of coli communis was one having the physiologic and cultural characteristics of the "X" bacillus of Sternberg and that of Havelberg, as case No. 4 will show.

Necropsy at Mercedes Hospital on a body dead of enteritis chronica.—Body of adult male; emaciation and rigidity; stomach contained a small quantity of viscid mucus, which was planted on agar. From the organs and blood developed mixed cultures; from the stomach a *pure* one of the following organism: A rounded rod; actively motile; 1 to 3 mm. long by 0.5 mm.; pleomorphic; does not stain after Gram.

On agar plates the young colonies are opaque and whitish, becoming on the surface an amber-colored, flat, glistening expansion, with markings in the peripheral zone, and irregular iridescent edges.

On gelatine there is no liquefaction, the young colonies showing a yellow, rather opaque center, and lighter granular periphery; on the surface becoming flat, whitish, and irregular; by transmitted light more or less amber or yellowish in color and iridescent.

In bouillon a dense diffusion and some pellicle. In litmus milk it coagulates from third to sixth day with acid reaction; clot remains solid. In Dunham's solution there is much indol; in glucose bouillon, 2 per cent, forty-eight hours, one-third tube gas, $\frac{\mathrm{H}}{2}\,\frac{\mathrm{CO_2}}{1}$; in lactose bouillon, 2 per cent, forty-eight hours, one-fourth tube gas, $\frac{\mathrm{H}}{2}\,\frac{\mathrm{CO_2}}{1}$; in saccharose, 2 per cent, forty-eight hours, one-third tube gas, $\frac{\mathrm{H}}{2}\,\frac{\mathrm{CO_2}}{1}$.

On potato a brown scum, with much indol odor. One remarkable fact about this organism was its *perfect motility when first isolated*, which soon was entirely lost, and only a sluggish turning of the individuals upon their axes indicated *true* motion. Nor could this motility be restored, either by growth in copious fluid medium, for we used it freely in exhausting from meat bouillon the muscle sugar, and tested its motility, or from its passage through animals to which it is intensely pathogenic.

This observation corresponds with Sternberg's assertion that the bac. "X," was at first actively motile, but it is now only a sluggish roller or twister, without the least translation. We have never found this actively translatory colon in the small or large intestine—here they are all sluggish—but have found it very frequently in the blood and organs and at times in the urine and sputum.

In a number of these cases of chronic enteritis we found only a pure invasion of proteus, usually viridens, and usually accompanied by b. pyocyaneus, in some part allowing it very free albuminoid growth, such as the surface of the mesentery, from which it will grow *at first* a pure violet, but on transplantation to another tube of agar will revert to green coloration. In a case of abscess of the liver with "blue pus" the organism on agar gave bac. viridens. In but one case was there a coccus infection which evidently preceded death, and in this, diagnosed by the attending physician as "typhoid fever," we found the body emaciated, the small intestine *normal*, liver enlarged, spleen enlarged and very soft; all else macroscopically normal.

Portion of spleen incubated twelve hours and sown on agar and in bouillon, from which there came a pure culture of a group coccus, motile, not liquefying gelatine, but maintaining its coccus form. At first it was thought to be b. melitensis, but finally it lacked the rod appearance of that organism.

These bodies were not selected, except that preference was given to continued types of fever and to chronic or acute bowel diseases.

The feces were examined in 10 cases, the urine in 8. The blood in every case was freely planted from the right side of the heart; the spleen and liver invariably.

As above stated, pseudo-typhoid bacillus was isolated once, and once also from the body of one dead of yellow fever. We can but conclude that the b. icteroides is not an ordinary denizen of the alimentary tract, whence it assists in the "secondary invasion" during an attack of yellow fever, or it would have been encountered among these diversified cases, taken from a people living in an endemic focus, and during the continuous presence of the developed disease.

One necropsy, No. 8, is of some importance because of the opinion expressed above concerning the probable mode of invasion of the b. icteroides and the seat of its localization. An adult male at morgue, unknown, save that he had staggered into a café at 10 a. m. of February 22, 1899, and died in an hour; evidently an American about 30 years of age; black hair; bloody froth from nostrils; some rigor (on 23d); much hypostasis, the skin of neck and face being bluish black; skin yellow-white; eyes yellow, pupils dilated; on section the vessels of the mesentery are engorged; the heart is in diastole, right full of very fluid blood; vasa vasorum dilated; pericardium and fluid normal, or yellowish; pleuræ normal; the lungs deeply engorged and some catarrhal pneumonia; mesentery shows numerous small extravasations between its layers; liver quite yellow and on section firm but not fibroid; it is decidedly fatty and mottled red; gall bladder contains some bile; urine is scant (3 c. c.) and albuminous; kidneys congested, but show no inflammatory changes of chronic nature; spleen is enlarged and fibrous; stomach mucosa is swollen, and eroded from post-mortem change; there are numerous extravasations into the submucosa which is stained a port-wine color; there are a few small free hemorrhages on the surface at the pylorus; the duodenum is full of dark fluid blood, its entire mucosa being extravasated and stained, that of the small intestine to a less degree; vessels of the brain and cords show congestion, the ventricles being full of serum. Cultures from heart blood and liver and the spleen and contents of the stomach.

From the findings we suggested to the medical attendant of the morgue that the case was one of yellow fever. But the blood in four tubes remained permanently sterile; the liver tubes (3) gave one growth of a motionless colon; the spleen was sterile; the blood in stomach gave a *mélange* of colon and proteus.

In this case the *odor* was intensely characteristic, as was that of the necropsy of Captain Williams, to which it bears a close comparison; and it was much more typical in all respects, save *color*, than that of Patrick Smith, undoubtedly dead from yellow fever.

Our original notes are closed with the expression, "A very promising looking necropsy gives nothing."

We now think that this case, like that of Captain Williams, was of the *siderante* type, with *no secondary invasion.* It also closely resembled that of Quintela Macias at necropsy, in which the bac. icteroides was obtained from the lung. This leads us to remark that the abuse of alcohol has long been looked upon as conducive both to contracting the disease and to its fatality, and we would suggest here the analogy between this fact and that of the frequence and fatality of pneumonia in those who habitually drink. We have no doubt that a liver almost incapacitated from fibroid changes would contribute largely toward a fatal termination in yellow fever, which so quickly disorganizes its parenchyma, but a lung deprived of its elasticity, passively congested, a ready nidus for germ infection, must play an important part not only in the contraction of the disease, but in its fatality also.

From these control cases we are prepared to say that the presence of the bacillus icteroides in any body is indicative of an infection of that body from yellow fever, although this does not question the possibility of the simultaneous growth of other pathogenic organisms and the production of symptoms peculiar to them in such body. We have frequently noted the symbiosis of b. icteroides with the plasmodium malariæ, with the bac. tuberculosis, and in one instance with the bac. typhosus.[1]

We therefore assume that our observations fully show that the bacillus icteroides is alone associated constantly with yellow fever, is never isolated from one not infected with yellow fever, and that its presence is alone sufficient to establish the diagnosis of the disease. In this connection we ask to submit specimen tube cultures of this organism from each of our cases, each tube labeled to show its origin. It is unfortunate that through mischance of expressage the larger number of the specimens isolated from our New Orleans cultures, and from cases in Havana prior to the war, were broken and lost to us. However, the two specimens from the New Orleans work, and one from the earlier Havana work, are quite sufficient to demonstrate the validity of the former, and the identity of the organism isolated in our Southern States with that of Cuba, and the one sent us from Brazil.

REACTION OF THE BAC. ICTEROIDES TO THE PROCESSES OF DISINFECTION.

Experiment and observation having demonstrated the almost constant occurrence of the bacillus icteroides in yellow fever; its absence in ordinary diseases prevailing in an epidemic or endemic habitat of yellow fever; its pathogenicity, toxicity, and communicability, it becomes necessary now to consider its behavior to physical and chemical agents employed in sanitary work for the suppression of the disease and the prevention of its spread.

First in order comes the determination of the

Thermal death point.

[× signifies growth; — signifies no growth. All experiments controlled.]

°C.	Minutes exposure.									
	1	2	3	4	5	6	7	8	10	12
56°	×	×	×	×	×	×	×	×	×	×
58°	×	×	—	—	—	—	—	—	—	—
60°	—	—	—	—	—	—	—	—	—	—

Result, 58° C., three minutes exposure.

The above result shows at a glance that the resistance of the organism to heat is very slight, and that a temperature far below that of boiling water would be efficient in theory, but is not, however, to be recommended in practice.

Disinfection.

CARBOLIC ACID.

Dilution.	Minutes exposure.										
	1	2	3	5	6	8	10	12	15	30	60
1-20	—	—	—	—	—	—	—	—	—	......	......
1-40	—	—	—	—	—	—	—	—	—	......	......
1-100	......	......	×	×	......	......	×	......	—	—	—

Result, 1-20, one minute; 1-100, fifteen minutes.

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[1] Sternberg quoting Agramonte. Centralblatt für Bakteriologie, Parasitenkunde und Infectionskrankheiten, Vol. XXV, Nos. 18 and 19.

Disinfection—Continued.

MERCURIC CHLORIDE.

Dilution.	Minutes exposure.								
	1	2	3	5	6	8	10	12	15
1-5,000	—	—	—	—	—	—	—	—	—
1-10,000	—	—	—	—	—	—	—	—	—

***Formaldehyde gas**, 3 per cent atmosphere, twelve hours exposure.*—Silk thread, dry, no growth; flannel, dry, no growth; silk thread, moist, no growth; flannel, moist, no growth.

Sulphur dioxid, 4 per cent atmosphere, twelve hours' exposure.—Silk thread, recently dried, no growth; flannel, recently dried, no growth; silk thread, moist, no growth; flannel, moist, no growth.

INFLUENCE OF DRYING.

Silk threads and small pieces of flannel were thoroughly wet with a virulent bouillon culture of the bacillus icteroides, placed for twenty-four hours in the incubator to insure a good growth, and were then dried over sulphuric acid, and when thoroughly dry the following experiments were instituted, the fabrics both remaining constantly in the drying chamber until withdrawn for experiment:

Threads.—One day, growth; two days, growth; three days, growth; four days, growth; five days, growth; six days, growth; seven days, growth; eight days, growth; nine days, growth; ten days, growth; eleven days, feeble growth; twelve days, no growth.

With the flannel the results were as follows, the experiments commencing on the day when desiccation was complete:

One day, growth; two days, growth; three days, growth; four days, growth; five days, growth; six days, growth; seven days, growth; eight days, growth; nine days, no growth.

In other words, textiles of two varieties resisted a "forced" drying much more active than the natural processes for nine and twelve days, respectively.

This possibly serves to explain why the contagium of yellow fever has often proved so resistant when no disinfecting processes have been carried out, and the experiments previously detailed serve to show what comparatively feeble disinfecting agents may serve to render the contagium harmless.

The following experiment serves, too, to show what an efficient means of disinfection is furnished by nature in *sunlight.*

A piece of sterilized flannel, containing about 100 square centimeters, was saturated with a virulent, active bouillon culture of the bacillus icteroides, which flannel was then kept in the incubator for two days at 37° to insure a full and active growth. The fabric was then transferred, still quite wet, to a covered dish of clear glass, and was exposed during twenty-four hours on the roof of the building, receiving perhaps nine or ten hours of full sunlight. Pieces were then cut off and planted in tubes of bouillon. One planting was sufficient to demonstrate that the exposure as detailed above had rendered the fabric sterile; there was no growth, though the experiment was repeated and controlled.

In the climate of Havana it was impracticable to make any experiments on the action of cold, but Novy, of Ann Arbor, Mich., has had exceptional opportunities for observation in this direction, and his experiments and observations are here quoted in extenso:

> The Sanarelli bacillus will not grow at zero C. Tubes of bouillon, agar, and gelatin inoculated with this organism and kept immersed in melting ice for two weeks showed no signs of growth. At the end of that time, when placed in the incubator they promptly developed; and these cultures were as pathogenic to guinea pigs as normal cultures. Even when kept for a month at zero degree the resultant cultures were fatal as usual to guinea pigs. The minimum temperature at which the b. icteroides will grow is about 10° C. Agar and bouillon cultures were allowed to develop at this temperature in an ice chest and were then allowed to remain there for five months. In other words, they were kept for five months at a temperature of 10° to 15° C. At the end of that time these cultures were transplanted to bouillon. One c. c. of this new culture, developed for thirty-six hours at 39° C., injected intraperitoneally into a large guinea pig, produced death in six days. Evidently no attenuation had taken place, and yet under these conditions one would expect to meet with a weakened yellow-fever germ. On November 29, cultures of the Sanarelli bacillus were placed outside the window and allowed to remain there for fifteen days. The average minimum temperature for that period was 26.4° F. (—3.6° C.), and the average maximum temperature was 36° F. (2.2° C.). At the end of this time the germs grew as well as before and their virulence was not diminished. The following experiment is of still more importance. Agar cultures of the b. icteroides were placed outside the window for three days during very cold weather. During the first day the temperature ranged from —2° C. to —13° C. The temperature of the second day ranged from —10° to 20° C., and on the third day from 0° to —15° C. It should be said that most of the time during these three days the temperature was below —10° C. At the end of the first, second, and third days transplantations into bouillon were made. These bouillon cultures were developed for thirty-six to forty hours at 39° C., and the resultant growths were normal in every respect. Each culture injected intraperitoneally into new guinea pigs in doses of 1 c. c. produced death in from eighteen to twenty hours.

These experiments demonstrate (1) that contrary to the experience with cholera, drying alone is not efficiently germicidal; (2) that almost any chemical germicidal agent is efficient if its application is thorough and intelligent; (3) that, failing these, the influence of strong direct sunlight and aeration can be relied on with reasonable certainty, but that (4) contrary to the generally received impression cold alone is unreliable and inefficient (Novy).

Experiment, then, has led us to draw the following deduction: That Wasdin's experiments have shown that the avenue of infection is through the respiratory tract; that during the first stages of the disease the b. icteroides is contained alive, active and virulent, in the bronchial secretion. More attention must be paid in the future to the sputum and the dust of apartments occupied by those sick with the disease; for his demonstrations, taken in connection with our findings as to the results of drying, prove from a laboratory standpoint, what has often been suspected from an epidemiological one, that the disease spreads more in dry, dusty weather, and that the spread is temporarily diminished by showers of rain, which for a time prevent the dust of an infected city or locality being blown about.

THE PRODUCTION OF TOXINS AND ANTITOXINS.

The consideration of the chemical products elaborated by and during the growth of micro-organisms opens up a most interesting and important field of observation. These products are in general of the albumose type; they are soluble in water, insoluble in alcohol and ether, and are precipitated from solution by alcohol, and also by the sulphates of ammonium and of magnesium. They are also capable of entering into chemical combination with the salts of the heavy metals, notably gold and platinum, and thus forming double salts of very definite composition. These products being chemical in their nature are, of course, incapable of reproducing themselves. They are of rather unstable nature; are rapidly deteriorated by oxidation, especially if in solution; are extremely susceptible to temperatures of over 60°, and are rendered largely inert by any prolonged or active chemical manipulation. Their ultimate chemical composition has not as yet been fully studied, but it can be conjectured from their action on the animal economy that they are alkaloidal in nature.

In the widest and most general sense of the term there are two forms of the substances, or possibly two distinct substances, probably the former. One is liberated during the process of bacterial growth, preferably in liquid media, small in quantity and of feeble intensity; the other is enveloped and contained in the microbial body; is liberated when the ectosarc is dissolved by an appropriate reagent, is larger in quantity and far more intense in action. A bouillon culture of a pathogenic microorganism of appropriate age, the microbial growth being arrested by heat, by chemical means, or by filtration through porcelain, constitutes one form of toxin, very potent in the case of some bacteria, as in the diphtheria bacillus, but very weak in the case of the b. icteroides and some others, notably the b. pestis. Three methods of the preparation of toxins from the b. icteroides will be here described.

(1) This form will be spoken of simply as "toxin," and was prepared by treating a fifteen-day old bouillon culture of the b. icteroides, ripened in a Fernbach flask at 37°, with a few drops of chloroform or by heating the culture at 60° for one to two hours.

(2) A much more potent toxin can be prepared from the b. icteroides by treating large quantities of culture grown on agar-agar by a solution which dissolves the ectosarc or outer layer of the bacterial cell, and liberates the enveloped toxin. This was prepared by inoculating agar on a large "moist chamber" (a Roux culture flask is preferable) by means of a swab, with a virulent bouillon culture of the b. icteroides. Grown at 37° for forty-eight hours there results a very heavy growth, which is scraped off the surface of the medium with a sterilized spatula, cover slip, or other convenient appliance. These scrapings are put into a small flask, the denuded surface of the medium washed with a little sterilized distilled water to remove as much of the growth as possible, and to the scrapings and washings in the flask is added a quantity of 0.6 per cent solution of potassium hydrate, and the flask securely stoppered. In a few days a remarkable change takes place in the contents of the flask. The microbial mass swells enormously, the liquid becomes thick and grumous, and then gradually the mass contracts and a clear yellow liquid is exuded. Culture from the flask from time to time shows that microbial life has been arrested, and microscopic examination of the deposit at the bottom of the flask shows bacterial detritus, but no complete forms. The body of the microbe has been dissolved and its enveloped toxin set free. Toxin thus set free will, in this report, be denominated "soluble," and is of special value in the immunization of animals in the preparation of antitoxic serums.

(3) Still another form of toxin was prepared and experimented with. Bouillon, containing in addition to its ordinary constituents 0.5 per cent gelatin, was put into a Fernbach flask, inoculated heavily with a virulent bouillon culture of the b. icteroides and allowed to ripen at 37° for fifteen to twenty-one days. The culture was then killed by a few drops of chloroform, the liquid put into a large beaker, thoroughly saturated with ammonium or magnesium sulphate, and a large excess of the precipitating substance added in crystals.

The toxin is precipitated out of solution in flocculi, which are rendered larger by the gelatin added to the bouillon, and owing to the high specific gravity of the liquid by the addition of the salts the flocculent, curdy mass rises to the top of the liquid. This is collected by straining through linen, dissolved in the least possible quantity of distilled water, and the solution filtered into strong or preferably absolute alcohol. A grayish-white amorphous precipitate results, which is collected on a filter, and can again be dissolved in water and reprecipitated by alcohol. Too frequent solution and precipitation renders the substance difficultly soluble in water, but increases its purity. It is finally collected on a filter, washed twice each with absolute alcohol and ether, dried in the air rapidly, then in vacuo over sulphuric acid, and reduced to powder in a sterilized mortar. The resulting substance will be designated "precipitated toxin." In our experiments, it was elected to precipitate by magnesia rather than by ammonia salts, for the reason that mice were the animals selected for the experiments, and the injection of considerable quantities of ammonia compounds into small animals is a process not unattended by danger.

With these substances Nos. 1, 2, and 3, the following experiments were performed. Toxins were prepared by method 1 from b. icteroides, b. typhosus, bacillus "X" (Sternberg), and b. coli communis.

February 14, 1899.—White mouse received subcutaneously 0.25 c. c. toxin b. icteroides; found dead at 8.15 a. m., February 15, 1899.

February 14, 1899.—White mouse received subcutaneously 0.25 c. c. toxin b. typhosus; sickened, but recovered.

February 14, 1899.—White mouse received subcutaneously 0.25 c. c. toxin bacillus "X" (Sternberg); no effect.

February 14, 1899.—White mouse received subcutaneously 0.25 c. c. toxin b. coli communis; no appreciable effect.

Of the toxins prepared by this method that of the b. icteroides alone was sufficiently potent to kill a white mouse weighing 17 grams.

Another series of experiments was as follows, toxins method No. 2:

February 25, 2 p. m.—Injected large white mouse with 0.10 c. c. soluble toxin b. icteroides. Found dead 8.30 a. m., February 26, 1899.

February 28, 1.30 p. m.—Injected large mouse with 0.20 c. c. soluble toxin b. icteroides. Found dead at 8.30 a. m., March 1, 1899.

February 28, 1.30 p. m.—Injected very large mouse (33 grams) with 0.15 c. c. soluble toxin b. icteroides. Found dead at 8.30 a. m., March 2.

February 28, 1.30 p. m.—Injected large white mouse (26 grams) with 0.10 c. c. soluble toxin b. icteroides. Found dead at 8.30 a. m., March 1.

As controls to the above experiments two mice were injected with respectively 0.10 and 0.20 c. c. sterilized 0.6 per cent solution of potassium hydrate. No ill effects resulted.

These experiments demonstrated that the toxin produced by the b. icteroides in ordinary process of growth is of somewhat feeble intensity, (2) but that there is contained within the microbial body of the same organism a toxin of considerable potency, easily released by an appropriate reagent.

With the precipitated toxins (method 3) of b. icteroides the following experiments were performed:

February 27.—Mouse (weight 25 grams) injected subcutaneously with 0.1 gram precipitated toxin b. icteroides; dead in twenty minutes.

February 27.—Mouse (weight 23 grams) injected subcutaneously with 0.1 gram precipitated toxin b. icteroides; dead in fifty-two minutes.

February 27.—Mouse injected subcutaneously with 0.09 gram precipitated toxin b. icteroides; dead in twenty-eight minutes.

February 27.—Mouse injected subcutaneously with 0.07 gram precipitated toxin b. icteroides; dead in one hour and twenty minutes.

February 28.—Mouse injected subcutaneously with 0.05 gram precipitated toxin b. icteroides; found dead 8.30 a. m., March 1.

February 28.—Mouse injected subcutaneously with 0.03 gram precipitated toxin b. icteroides; found dead after several days.

February 28.—Mouse injected subcutaneously with 0.01 gram precipitated toxin b. icteroides; rendered very sick, but survived.

As it was known that the toxin as prepared contained a considerable quantity of the precipitating agent—magnesia in this instance—a quantitative estimate was made of this substance by precipitating as ammonio-magnesian phosphate and subsequently burning to magnesian pyrophosphate. This gave MgO 79.98 per cent; consequently the dose in all the above experiments of actual toxins, or rather of mixed albumoses, is represented by 100−79.98=20.02 per cent—practically 20 per cent of the dosage set forth.

These experiments satisfactorily demonstrated to us the very intense toxicity of the substances isolated and the highly virulent nature of the organism of which we were taking account. We noted that the effects of the toxins were almost fulminant in character; that often before the mouse was released from the forceps which held him he was practically in articulo mortis, profoundly unconscious to external stimulations, the legs spread out, and the animal as if flattened by some heavy weight; respiration very much hurried and shallow, gradually becoming gasping and diaphragmatic; the action of the heart becoming more and more labored. The effects of the substances seemed to be exerted on the whole axial nervous system, especially on the respiratory and circulatory centers. In the cases where recovery took place after the smaller doses, it was noted that the effects of the intoxication seemed very transitory; that the animal recovered as if from a profound narcosis, and while quite sick for several days gradually recovered tone and vigor. How truly this corresponds to the clinical picture in the human being suffering from yellow fever, where the individual at the very verge of dissolution is suddenly restored to a species of semi-existence by the resumption of the function of the kidneys, and gradually goes on to a delayed but full convalescence.

With a view to determining the relative as well as the actual toxigenic power of the b. icteroides, toxins were prepared from the b. coli communis and the b. typhosus. The former was injected into a mouse in doses of 0.1 gram without fatal results; the latter was tried repeatedly until it was established that, while an animal of average size would support doses of 0.5 and 0.6 gram without ill effect, a dose of 0.7 gram killed in one hour and forty minutes. Making due allowance for the 80 per cent magnesia contained in the toxins precipitated by this method, it still makes the lethal dose of the typhoid toxin prepared by us many times larger than that of the typhotoxin prepared by Vaughan and Novy, whose method, however, it was not convenient to pursue.

Efforts were not wanting on our part to eliminate the large content of magnesia and to obtain our toxic substances in a state of greater purity and concentration. It was a simple matter to eliminate all the magnesia by precipitation as ammonio-magnesian phosphate, separating this by filtration and precipitating the filtrate with absolute alcohol. This precipitate was collected and dried, was found to be with difficulty soluble in water, and had lost its toxic power; a mouse sustained a maximum dose (0.1 gram) without any ill result.

While much work has been done abroad and by Vaughan and Novy in the United States in the isolation of the toxic substances of the pathogenic bacteria, it is obvious that more finished means to this end is a desideratum. The methods pursued by us are, practically, those pursued at the Institut Pasteur in the preparation of toxins as one step in the immunization of horses against the b. pestis.

An impression has long prevailed that the elimination of the toxins of the yellow-fever organism occurred through the kidneys; indeed efforts have been made to prepare an antiamaryllic serum by the immunization of horses by means of the urine of yellow-fever patients and convalescents. In our experiments it was noted that those mice which urinated freely during the continuance of the intoxication seemed to survive longer or even to recover. Our assistant, Acting Assistant Surgeon Menocal, was therefore directed to try the precipitation of toxic substances from the urine of three cases of yellow fever (one ending in death and two in recovery) by two methods: (1) by precipitation along with the serum albumen by means of absolute alcohol, and subsequent purification by dialysis; (2) by precipitation along with the albumoses and globulins, with subsequent purification by solution in water and reprecipitation by alcohol, essentially as described in method No. 3.

The following experiments were made:

With toxic substances precipitated from the urine by alcohol, from a severe, nonfatal case of yellow fever: Mouse injected subcutaneously with 0.06 gram; dead in one hour and thirty minutes.

With toxic substances precipitated from urine of fatal case of yellow fever (precipitated by alcohol): Mouse injected with 0.06 gram; dead in fifteen minutes.

With substances precipitated by alcohol from the urine of a mild case of yellow fever: Mouse injected subcutaneously with 0.06 gram; rendered very sick, but recovered.

With toxic substances precipitated by means of magnesian sulphate (globulins and albumoses) from urine of fatal case: Mouse injected subcutaneously with 0.05 gram; dead in three hours.

With substances precipitated by sulphate magnesia (globulins and albumoses) from urine of mild case: Mouse injected subcutaneously with 0.05 gram; sick, but recovered in a few days.

These experiments are interesting as seeming to prove the contention given above as to the elimination of the toxins, and also as seeming to show that in a fatal, a grave, and a mild case the potency of the substances and the time of death of the animals subjected to experiment was in direct relation to the gravity of the case.

An impression has prevailed, too, and has been advanced as a fact, even, that be the specific cause of yellow fever what it might, there was a large element of danger in a secondary infection by means of the b. coli communis. If this be so it would seem naturally to be due to an absorption of elaborated toxins; and while the theory is admitted as a possibility the following experiment would seem to negative the idea:

A mouse injected subcutaneously with 0.05 c. c. soluble toxin b. icteroides dead on eighth day.

A mouse injected subcutaneously with 0.05 c. c. soluble toxin b. icteroides +0.02 gram precipitated toxin b. coli commun., survived without any ill effect.

It is here permissible to refer to a theory advanced by one of us (Geddings) in 1894, that a part of the difficulty of isolating a specific microbe in yellow fever was due to the possibility that the specific organism was inhibited or destroyed in the substances elaborated in its process of growth (toxins). The following experiment made by us would seem, in a measure, to confirm this theory:

Into a test tube containing 10 c. c. of bouillon was put 0.20 c. c. of soluble toxins b. icteroides, and in this mixture was planted an active culture of b. icteroides. In twenty-four hours there was an evident precipitation at the bottom of the tube, but no growth was obtained by inoculating other bouillon tubes. The inoculations were repeated from tube to tube for six generations without result of any growth. The experiment was repeated by using a quantity of the precipitated toxins of the b. icteroides 1–100. Similar results were obtained—a precipitation in the first tube and no growth in a series of tubes planted from it.

A still further test was made: Three tubes containing precipitated toxin 1–100, as above, were inoculated, respectively, with b. icteroides, bacillus "X" (Sternberg) and b. coli communis. In the first tube containing the b. icteroides there was a precipitation, but it was impossible to obtain a growth by transplantation. The bacillus "X" and b. coli communis seemed very slightly inhibited in the first tube, but from subsequent transplantations gave cultures normal in every respect.

On the contrary, the toxin of the b. coli communis has no effect upon the growth of the b. icteroides, as is demonstrated by the following experiments: To a tube of bouillon was added precipitated toxin of the b. coli communis in the proportion of 1–100, and in this tube was planted a culture of the b. icteroides. In twenty-four hours the tube presented the appearance of a culture of the b. icteroides normal in every respect, and transplantations to other tubes of bouillon and agar-agar confirmed this view. Therefore the toxin of b. coli communis is not inhibitory or germicidal to the b. icteroides.

But little can be said here as to the use of the "serum antiamaryll" of Sanarelli, either for or against. As directed by the Surgeon-General of the Marine-Hospital Service, an effort was made in 1897–98 to introduce its use into the Spanish military hospitals in Havana, and while, as usual, the request was politely entertained, from the questions asked and the nature of the information requested it was obvious that full permission would never be accorded. Surgeon Wasdin had a limited opportunity to observe its effects in New Orleans in 1898, and felt obliged to report that the case in which there was a favorable termination after its use would have probably recovered without it, and that it was without effect in a grave case, finally terminating fatally.

The action of serums may be broadly divided into three classes, (1) those which prevent infection by their influence on the economy, stimulating the leucocytes to increased activity against the living germ (phagocytosis); (2) those which, in addition to the above property, stimulate the *whole* cell economy to the production of an antitoxin, or supply in themselves an antitoxin for the neutralization of the toxins produced by growing and multiplying microorganisms; (3) those whose power is exercised directly upon the microorganism itself, having no power to stimulate phagocytosis, or to supply or cause the elaboration of an antitoxin—the so-called "alexins." To this class it would seem that the "serum antiamaryll" must be relegated.

The following experiment was made:

Mouse inoculated at root of tail with 1 loop of seven-day-old culture b. icteroides, dead on seventh day.

Mouse inoculated at root of tail with 1 loop of seven-day-old culture b. icteroides with 0.20 c. c. serum antiamaryll dead on tenth day.

The animals being of practically equal size and weight, and the quantity of culture administered being equal, the most that can here be claimed is that the serum prolonged life for three days, but in no way prevented a fatal issue.

A brief exposition may here be entered into as to the requirements of an efficient serum or antitoxin. Experience has demonstrated that in the case of several of the pathogenic organisms it was a comparatively simple matter to immunize a horse or other domestic animal to a point where a dose of the said serum, usually large, would either prevent infection or modify it to a considerable extent. Such serums *may be* simply *alexic*, or may, as before said, act by stimulating the leucocytes to increased phagocytic action. They can be only considered, therefore, as *protective* or *preventive* serums. To claim power as a true "antitoxin" much more is required. In this case not only must the agent protect against culture (living organisms), but it must go much further, and be proved to be capable of neutralizing the toxins of a disease after infection has fully taken place and the disease in question is well established. As an instance: It was comparatively an easy matter in the preparation of the antipest serum at the Institut Pasteur to prepare a serum which would protect mice, rats, and guinea pigs against a mortal dose of a culture of the b. pestis, but a far different matter to prepare one which would protect similar animals against toxins of the disease, isolated and administered, or which would prevent a fatal issue when the malady was once established by inoculation with the organism. An antipest serum, therefore, was not pronounced effective until it had not only proved its efficacy against a mortal dose of the live organism, but *until a dose of 0.10 to 0.20 c. c. would protect a mouse against a four-times mortal dose of the precipitated toxins.* This requirement may seem exalted, but is, in our opinion, just and proper, and we believe that until a serum against yellow fever somewhat approaching these requirements shall be produced, the question must be regarded as still unsettled.

Therefore, with no anticipation that the serum antiamaryll of Sanarelli would answer the requirements, or indeed, that at this stage it would be fair to demand that it should, the following experiments were instituted:

February 26.—Mouse received 0.10 c. c. soluble toxins b. icteroides at 2 p. m.; found dead at 8.30 a. m., February 27.

February 26.—Mouse received 0.10 c. c. soluble toxin b. icteroides, with 0.20 c. c. serum antiamaryll, at 2 p. m.; found dead at 8.30 a. m., February 27.

February 27.—Mouse received 0.1 gram precipitated toxin b. icteroides; dead in twenty minutes.

February 27.—Mouse received 0.1 gram precipitated toxin b. icteroides with 0.20 c. c. serum antiamaryll; dead in forty-five minutes.

Therefore it must be admitted that the serum failed signally to protect an animal against toxin, and consequently that it can not be claimed to be a true antitoxic serum or antitoxin.

EXPERIMENTS ON AGGLUTINATION AND ARREST OF MOTILITY.

The wide application of the reaction of Widal, its modification at the hands of Wyatt Johnson in the United States, and the published work of Archinard and Woodson of the results of their experiments in New Orleans during the epidemic of yellow fever in 1897, rendered it necessary that we should make every effort to supply some test similar to the Widal as a means of rapid and ready diagnosis of yellow fever. Experiments were therefore made on b. icteroides with various serums and in varying dilutions; with the blood of yellow fever patients and with the blood of animals sick or dead as the result of inoculation with b. icteroides. The results were most varying and bewildering, and convince us that whatever may be the value of the reaction as a diagnostic point in enteric fever, it has little or none in yellow fever. Following is a transcript of the experiments made.

B. icteroides with serum antiamaryll, diluted 1–4,000.

	Fifteen minutes.	Thirty minutes.	Sixty minutes.
Agglutination	A small clump	No additional clumping.	Decided clumping.
Arrest of motility	Unchanged	Slightly impaired	Decided impairment.

B. icteroides with Serum Antiamaryll, diluted 1–2,000.

Agglutination	Slight	Increasing	Decided.
Arrest of motility	Impaired	Complete arrest	Absolute arrest.

B. icteroides with Serum Antiamaryll, diluted 1–1,000.

Agglutination	None	None	Practically none.
Arrest of motility	Not impaired	Not impaired	Not impaired.

Claims having been made that the motility of the B. icteroides was affected and agglutination produced by various other serums (antitoxins) and by the serum of normal human blood, the following experiments were made, the dilution being 1–10 unless otherwise stated, and the times of observation fifteen, thirty, and sixty minutes, respectively:

B. icteroides with New York Health Department diphtheria antitoxin 1–10.

	Fifteen minutes.	Thirty minutes.	Sixty minutes.
Agglutination	None	None	Practically none.
Motility	Not impaired	Not impaired	Not impaired.

B. icteroides with antipest serum (Pasteur Institute) 1–10.

Motility	Slightly diminished.	Slightly diminished	Slightly diminished.
Agglutination	None	None	None.

B. icteroides with serum antivenin (Pasteur Institute, Lille) 1–10.

Agglutination	None	None	None.
Motility	Unchanged	Unchanged	Unchanged.

B. icteroides with typhoid serum[1] 1–40.

Agglutination	Slight	Slight	Slight, but marked.
Motility	Impaired	Impaired	Much impaired.

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[1] The typhoid serum here referred to is the serum of a horse treated with killed cultures of the b. typhosus, and having an agglutinative reaction on the b. typhosus in the proportion of 1-200000.

B. icteroides with typhoid serum 1–100.

Agglutination	None	None	None.
Motility	Impaired	Impaired	Impaired.

B. icteroides with heart blood of rabbit injected with organism from control necropsy No. 6.—After an exposure of two hours and forty-five minutes there is a slight formation of small clumps, but no general agglutination and no impairment of the motility of individual organisms.

Blood of P. W. S. (a case of yellow fever), dilute 1–10.—After an exposure of two hours and fifteen minutes there is no agglutination and no arrest of motility.

The same diluted 1–20.—After an exposure of one hour there is no agglutination and no arrest of motility, and the experiment was suspended on account of the drying of the drop.

B. icteroides treated with the blood of Atwood, diluted 1–20.—Fifteen minutes, diminished motility; thirty minutes, much diminished motility; formation of decided clumps; forty-five minutes, motility progressively diminishing, and size of clumps increasing; sixty minutes, motility in general diminished at least four-fifths; impaired motility of all organisms, and total arrest of the large majority. General formation of large clumps.

This result possessed much interest, being arrived at in the first few days of Mr. Atwood's illness. It became much more so when subsequent developments proved that the case was one of *gastric ulcer* and not yellow fever.

APPENDIX A.

NOTE ON THE SIMILARITY BETWEEN BAC. ICTEROIDES AND BAC. CHOLERÆ SUIS.

Almost at the close of our work in Havana there appeared in the Medical News of April 29, 1899, a communication from Drs. Reed and Carroll, of the Army laboratory, in which they called attention to a marked resemblance between these two organisms—a resemblance culturally so striking as to induce these observers to submit the domestic hog, a special reagent of bac. choleræ suis, to the influence of bac. icteroides placed in their food. This resulted in the infection of a number of these animals in which necropsic examination showed the typical ulcerations of the small intestine found in those dead of choleræ suis.

Only two cases of this infection are given in the communication mentioned, in reality but one, since the second pig merely died of what the first one did, having been fed upon its infected organs. From our experience given above, with two domestic pigs, six weeks old, fed upon the most virulent cultures of bac. icteroides, we can but doubt the accuracy of these observations, and are forced to reflect that from the fact of the observation of this resemblance the bacillus choleræ suis must have been brought into association with bac. icteroides. If so, there exists the possibility of a mixed culture of these so similar organisms, and this fed to domestic hogs would undoubtedly terminate fatally, with the characteristic ulcerations of hog cholera. These reflections arise from our contrary experience with pure cultures of the bac. icteroides, and as the result of our experiments with this bacillus upon hogs at the Delaware Breakwater Quarantine free from any probability of infection from the bac. choleræ suis.

Reverting to the communication above mentioned, we must express our surprise that these observers, after stating that the organism of Sanarelli possesses a most marked specificity, equaling that of b. choleræ suis, of which they consider it a variety, advance the proposition that it, when found in cases of yellow fever, is one of the secondary organisms, such as the colon and proteus, which invade the body in the "last hours of life."

From this we could almost assume that the organisms in question can originate de novo, and if it can give rise to yellow fever, then the old theory of the spontaneous evolution of this disease is again introduced. We can not assent to this proposition. The work of Sternberg, who says, "In the series of cases studied by me secondary infections were extremely rare,"[1] and the work of Sanarelli and our own is opposed to the barest possibility that the bac. choleræ suis could have been present in the intestinal content and not have been discovered.

As before intimated, Dr. Sternberg's work was too limited, its field too narrowed for the detection of the organism, for he confined his observations principally to the alimentary tract, and in at least half of his necropsies does not mention planting the heart blood. In making this statement we realize the advances made in bacteriologic technique in the decade that is passing, nor can we underestimate the fortuitous chance that placed in Sanarelli's hands such cases as his No. 2 and No. 8, cases only approached in the ease of isolating the germ by the one, in our experience, of Patrick W. Smith of our series.

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[1] Annual Report Am. Pub. Health Assn., 1898.

On May 25 two fawn-colored mice were placed in a sterile glass case, and 2 c. c. of fresh bouillon culture of bac. choleræ suis added to their water and food.

June 4 one mouse was found dead, just ten days from time of exposure. Necropsy showed much engorgement of the vessels of the skin and mesentery; the liver was reddish in color; spleen normal or enlarged a little; kidneys congested; urine, none; right heart full; pericardium and pleuræ normal; stomach contains no black vomit; mucosa congested; that of duodenum coated with bloody mucus; lungs apparently normal; cultures from the blood all gave a pure culture of the bac. choleræ suis.

On the 5th, at 6 a. m., the second mouse is found dead. Necropsy shows decomposition of the organs; the liver is yellowish; the spleen is much enlarged; stomach normal; small intestine congested. From blood planted there develop pure growths of the bac. choleræ suis.

On May 28 two large brown rats,.from the same source, were caged separately in sterile glass cages, and to one was given 2 c. c. of fresh bouillon culture of bacillus icteroides from Bologna, and to the other 2 c. c. of fresh bouillon culture of bacillus choleræ suis.

On June 1 there was again given 1 c. c. of the same organisms to the respective rats.

On the 4th the hog-cholera rat seems quite sick; the other very droopy.

On 6th both are doing very well.

On 8th both improving, and are killed with formaldehyde gas, because of closure of our laboratory; no necropsies.

Attention is called to the same result in the case of the large white rat fed on b. icteroides, whose history is given above.

THE "PFEIFER REACTION" TEST BETWEEN THE BAC. ICTEROIDES AND BAC. CHOLERÆ SUIS.

On May 19 two large fine guinea pigs were selected, as nearly alike in size and weight as possible, their abdomens shaved and sterilized and the skin incised with one stroke of the sterile scissors down to the muscular walls, then with sterile glass pipettes, readily forced through the parietes thus exposed, we introduced into the cavity of the abdomen of pig No. 30 1 c. c. of a mixture of a twenty-four-hour bouillon culture of bac. icteroides (Smith) and serum antiamaryl of Sanarelli in the exact proportion of 1–20. Also, and coinstantaneously, into pig No. 31 we introduced 1 c. c. of a similar culture of bac. choleræ suis and serum antiamaryl of Sanarelli, in the exact proportion of 1–20. Both animals stand the quick punctures well. In twenty minutes a few drops of fluid were withdrawn from the cavity of each pig and immediately examined in hanging drop. The bacilli icteroides were found *motionless*, more or less granular and deformed or bent, and tending to groups of several elements agglutinated. Stained, this cover slip showed *less reaction* to methyl blue after long exposure; a granular appearance of the bacilli; some were vacuolated and many in small clumps. In forty minutes the same pig gave serum which in hanging drop showed fewer bac. icteroides, more granulation and distortion of the rods, many fragmented and none in motion. This cover slip stained in methyl blue gave small aggregations of disorganizing rods, granular, and not reacting well to the stain. At the end of sixty minutes we found the serum so bloody that no correct observation could be made.

In pig No. 31, at the end of twenty minutes, the extracted serum gave hanging drops in which numbers of bac. choleræ suis could be seen under strong inhibition, the motion being very slight and rotatory. The end of the rods impinging against the glass gave them the appearance of cocci. None were observed in the condition of granulation or of deformity, although there were a few aggregations of elements. Stained with methyl blue they reacted normally. In forty minutes the rods were fewer in number, but of sound appearance, and reacted well to the stain.

As in pig No. 30, I found the abdomen so full of blood at the end of sixty minutes that no observation could be made.

These microscopic observations bear closely upon the observations of Pfeifer in the case of his antiinfectious serum of cholera, and he claims that under these conditions no organism will be affected except those of the same kind. From them we would say that b. choleræ suis is absolutely distinct from b. icteroides. However, similar experiments with pigs injected with icteroides and serum antiamaryl have ended with us in the death of the pig.

On May 19 both pigs have reacted well; are quiet, and do not try to eat. They remain ill until the 26th, when No. 31 dies at 4 p. m.

On the 27th No. 30 is found dead at 6 a. m., evidently for several hours.

Necropsy No. 31.—Done at once. Skin vessels are congested, as are those of the mesentery; the liver is of a yellowish color and mottled and looks *fatty;* the spleen is *greatly* enlarged; the lungs are congested; right heart distended; the kidneys are swollen; the mucosa of stomach is normal; its content greenish; the duodenum contains some blood-stained mucus; mucosa is stained; the uterus is much congested; urine contains 3 per cent moist albumen. With osmic acid the liver cells show fatty degeneration quite extensively. Liver gives amount of extracted fat by weight: Fresh, 10.000 grams; dried, 2.625 grams; residue, 1.975 grams; fat, 0.650 gram, or 6.5 per cent of fresh and 25 per cent of dry.

Cultures were taken from heart and spleen and both gave pure cultures in abundance in twenty-four hours of a bacillus that differs from b. icteroides in producing H_2S in bouillon cultures, or choleræ suis.

Necropsy of pig No. 30.—Several hours dead; vessels of the skin distended; tissues dry; mesentery of small intestine engorged; the liver is of a light yellow tint and friable; spleen is normal in size; right heart distended; the pleuræ ecchymotic; lungs deeply congested; stomach mucosa deeply stained by submucous extravasations, but there is no free blood; the duodenum appears the same; bladder contains albuminous urine. Hepatic tissue teased in osmic-acid solution gave extensive fatty change in the cells, there being very few cells in which the black granules of fat were not seen.

Extracted fresh with ether and this weighed gave in 10.000 grams 1 gram of fat, or 10 per cent; dried, 2.670 grams, or 37.23 per cent, fat; residue, 1.670 grams; fat, 1 gram; cultures from blood; the organs fed to two domestic pigs.

In twenty-four hours one of these tubes appears sterile, on the other one there is a suspicion of growth. After forty-eight hours the latter has from 5 to 10 isolate colonies, quite small; the first has three minute isolate colonies and a better growth in the water of condensation.

In the case of pig No. 31, the tubes were beautifully grown at the end of twenty-four hours, and have continued in marked contrast to the inhibited growths from pig No. 30.

Both organisms are translatorily motile. Therefore, although the serum antiamaryll is not an antiinfectious one, and does not in its present potency result in saving the animal from infection, it has in our hands lengthened the period of disease several days in animals.

EXPERIMENTS AT DELAWARE BREAKWATER QUARANTINE.

The following is the result of the experiments mentioned above, to determine any possible relation between the b. icteroides and the b. cholerae suis:

At the quarantine station at Delaware Breakwater seven pigs of the same litter and about two months old were put into a new sty, and kept under observation for three or four days to assure ourselves of their freedom from any disease. They were then separated and six were put into one pen and one into another to serve as a control.

July 4, 1899.—To the six pigs were fed the following: 12 cultures on agar-agar of the b. icteroides, forty-eight hours old, derived from culture received direct from Professor Sanarelli at Bologna; 12 cultures on agar-agar of the b. icteroides, forty-eight hours old, derived from culture isolated by us in Havana, Cuba; 500 c. c. of bouillon culture b. icteroides, forty-eight hours old, derived from Sanarelli's Bologna culture.

July 5, 1899.—Pigs appear in perfect health. Fed with 500 c. c. seventy-two-hour-old bouillon culture b. icteroides, derived from Sanarelli's Bologna culture, and on the evening of the same day 500 c. c. more of the same culture.

July 6, 1899.—The pigs seem in perfect health and during the day receive a further feeding of 500 c. c. of a similar bouillon culture of the b. icteroides.

Therefore in forty-eight hours the six pigs receive 24 agar cultures, and 1,500 c. c. of bouillon cultures of the most virulent specimens of the b. icteroides of which we are in possession.

The pigs were carefully watched during the time intervening until July 14 (ten days from the first feeding), and at no time was there any loss of appetite, or any indication of sickness whatsoever. On this day, July 14, three of the fed pigs and the control were killed. The stomach, organs, and the intestinal canal of the control pig were normal in every respect. The stomachs, organs, and intestinal canals of the three fed pigs presented no lesions indicative of any infection from the b. icteroides, *and were absolutely and entirely free from any appearance which could be considered as indicative of the well-known lesions of hog cholera.* Further, at this date, July 23, the three remaining pigs have remained in perfect health and show no indications either of the disease produced by the b. icteroides (yellow fever) or of hog cholera.

From these experiments, then, we deduce—

I. That the domestic pig is incapable of infection by the b. icteroides when introduced through the intestinal or digestive tract.

II. That the b. icteroides when fed to pigs will *not* produce any of the symptoms or intestinal lesions characteristic of hog cholera, as claimed by Reid and Carroll.

APPENDIX B.

INVESTIGATION INTO THE CAUSE OF YELLOW FEVER.

PRELIMINARY REPORT OF MEDICAL OFFICERS DETAILED BY DIRECTION OF THE PRESIDENT AS A COMMISSION TO INVESTIGATE IN HAVÁNA THE CAUSE OF YELLOW FEVER.[1]

SIR: I have the honor to submit the following general summary of the work of the commission appointed by you, with the consent of the President of the United States, for the purpose of investigating the etiology of yellow fever.

Introductory to this, I must mention the work done by me, prior to this detail, in this direction, during the prevalence of the yellow fever along the Gulf coast of Mississippi and Louisiana during October and November of 1897.

In compliance with your directions I had commenced such investigation at Ocean Springs, Miss., during the latter part of September, visiting a number of cases, and securing tube cultures from the living blood. Early in October, through the courteous invitation of Dr. S. R. Olliphant, president of the board of health of Louisiana, and of Prof. P. E. Archinard, bacteriologist to the board, and by your permission, I joined Dr. Archinard in the investigation being conducted by him in New Orleans, where the fever existed. This investigation had been instituted by the authorities of the Charity Hospital, and to Dr. Bloom, the courteous superintendent and resident surgeon of that institution, I am indebted for the privilege of visiting the isolation division of that hospital, and the valuable opportunity of working in conjunction with the gentlemen detailed for that especial duty. Other than a study of the large number of cases of the disease at this hospital, which I estimate an invaluable experience, I entered actively into the pathologic and bacteriologic work. A detailed description of this work would anticipate the report of the pathologist in the proposed general report of the epidemic by the authorities of the Charity Hospital, since it was assumed that any and all work done would be for the use of that institution. It suffices to state that it was impracticable to make, during the limited continuance of the fever, extensive bacteriologic examination of any individual case, owing to the number of necropsies held during this time; and it was necessary to postpone examination in most cases to a later date, the cultures from the blood and organs being carefully preserved, together with those obtained at Ocean Springs.

I should here refer to the uniform courtesy of the gentlemen who formed the general staff of the isolation hospital, Drs. Veazie, Hamilton, Jones, and Pothier, with whom it was a pleasure to be associated. The bacteriologic work was carried on in the laboratory of the medical department of the Tulane University, under the direction of Professor Archinard, from whom, and the dean of the college, Prof. S. E. Chaille, many courtesies were received by myself and P. A. Surg. H. D. Geddings, who had joined me in this portion of the work. Upon the receipt of your order on November 11, 1897, to proceed to Havana and there continue the investigation into the cause of yellow fever, we proceeded to do so as early as practicable, all the culture material, almost entirely obtained from necropsies, little attention having been devoted to fresh blood plantings, being carefully transferred to that city.

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[1] Reprint from Public Health Reports, November 11, 1898.

Our reception by the Captain-General of Cuba, General Blanco, was marked by a kindness which presaged the most satisfactory arrangements for the conduct of the investigation, and we received an early introduction into the military hospital of Alphonso XIII, that at Regla, and that of St. Ambrosio. Owing to unavoidable delays the laboratory installation was not completed until near the middle of January, 1898, and from this time until our work was discontinued, on March 16, by your direction, the number of cases of yellow fever was very limited. It was during this period that opportunity was had to thoroughly examine the cultures obtained in the United States. Here I must state that an impetus had been given the matter of etiologic investigation by the Annales de l'Institut Pasteur for June, 1897, of the claim by Prof. Guiseppe Sanarelli, of the University of Montevideo, Uruguay, that he had discovered in his bacillus icteroides the cause of this disease.

The semidetermination of Dr. G. M. Sternberg, U. S. A., that the bacillus X (bacillus cuniculicida Havaniensis), discovered by him in 1889, was the cause of this fever, had been withdrawn,[1] and the claim of other discoverers negatived,[2] so that it was incumbent upon us to at once ascertain whether the organism which Sanarelli described, the bacillus icteroides, was to be found in the cultures made by me in New Orleans, and, if so, to ascertain by comparative necropsies, performed upon bodies of those dead from disease other than yellow fever, whether this new organism had been overlooked, or not detected by Sternberg in his justly celebrated work in this field, since he had declared that there was nothing in the blood or organs of yellow fever patients which he had not detected. To this end each case necropsied at New Orleans was patiently and thoroughly plated from young bouillon cultures from the original and subsequent plantings, these originals having been taken from blood, spleen, liver, and kidneys, the portions of organs in many cases having been incubated twelve hours prior to the inoculation of the tubes, as advised both by Sternberg and Sanarelli. Besides these cultures, those taken from living patients at the isolation division of the Marine-Hospital detention camp at Fontainebleau, Miss., were also carefully examined. It was from the blood of one of these cases, "Goodrich," planted on September 28, 1897, that the most typical forms of colonization, to those described by Sanarelli for bacillus icteroides, were noticed, of a small rod, actively (at first) motile, not retaining the stain after Gram, but which later in New Orleans gave rise to the production of indol and the formation of gas with both glucose and lactose. This organism, as at first noted, more nearly resembled that of Sanarelli than any other isolated at the time we left the laboratory at New Orleans, and it was now taken up for more careful observation than had been then possible. For unanimity of purpose it was thought best that each of us should prepare, independently, cultures of each and every specimen on hand, and carry them to a definite termination, a decision which afforded much satisfaction at the termination of the tedious and exacting labor of plating and replating so large a number of organisms, in that while we succeeded in a number of cases in detecting the organism in both sets of cultures, it occasionally occurred that it was found by only one of us in a special one. It is gratifying to say that the organism was readily and quickly isolated by both of us from the "Goodrich" cultures, since the contamination, which shrouded its fine characteristics in regard to gas and indol production, was a simple colon bacillus. This was, therefore, the highly motile organization first noted by me at Ocean Springs, and which could only have been that of Sanarelli, or, as was feared, one of the proteus family, and therefore the earliest Sanarelli organism isolated after that author. Early in our effort to detect this new bacillus it was ascertained that its symbiosis with any member of the colon group materially influenced its marked motility, the germ seemingly becoming inhibited by the product of the colon organism, both in growth and motility. Bearing this in mind, it became an easier matter to detect it, and it was my fortune to isolate it from the cultures on hand in 42 per cent.[1] Concomitantly with this work it was my especial effort to determine whether the bacillus icteroides was to be found in the blood or organs of bodies dead from *other* diseases than from yellow fever, and for this purpose I conducted at the city morgue, and more frequently at the morgue of the Hospital de Alphonso XIII, a number of necropsies (21), selecting bodies of patients who had suffered from malaria, with no suspicion of specific yellow fever, or from dysentery. With the exception of necropsy No. 6, none of these gave an organism approaching in characteristics that of Sanarelli, the majority of cases giving an admixture of colon and proteus in variety.

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[1] Report on yellow fever; Sternberg, 1890, U. S. M. H. S.

[2] Idem.

In this exception the organism isolated so fully met the demands of Sanarelli, in regard to its growth and physiologic aspects, that it was thought the bacillus had been found in this case of simple camp dysentery, until on the fifteenth day it was found to be quite slowly liquefying gelatin 20 per cent in combination with 1 per cent agar. Further plating in effort to eliminate any contamination to which such liquefaction may have been due was prevented by our departure from Havana. I could not differentiate the organism from that of Sanarelli when compared in living culture, or in stained preparation under the microscope, and it differed widely from the slowly liquefying proteus organisms. Its influence upon animal life I had no opportunity to test. During this time we had received notification of, and invitation to see, five cases of so-called yellow fever—one through the courtesy of a private practitioner and four in military hospitals. Of these I differed in the diagnoses of two, the one in private hospital and one at the military hospital in Regla, a suburb of Havana. In the three others I concurred in the diagnosis. Fresh blood from the carefully cleansed ear-tip was taken in sterile glass bulbs, from each case after the manner of Sternberg, the capillary tube being at once sealed hermetically. It is a matter of moment that in each of the cases which I had diagnosed as yellow fever the organism was found by both of us, and fortunately in the one in which I failed to detect it it was detected by Dr. Geddings, and vice versa. In the two not thus diagnosed it was detected by neither of us, although especial effort was made to do so. While I do not wish to anticipate a collaborated report of the technical work performed in the laboratory at Havana, I will briefly state that from the organisms isolated by us from the home and foreign cultures we demanded an absolute compliance with all the requirements of Professor Sanarelli in the case of his bacillus icteroides, as follows: An indefinite growth upon gelatin without its liquefaction; the same in sterile milk without precipitation of its casein; the nonproduction of gas from the decomposition of sugar, glucose or lactose, in bouillon (here it will be mentioned that all sugar tests were made with bouillon from which all muscle sugar had been extracted by a growth of bacillus coli communis for a suitable time, for in this it was found that bacillus icteroides, as obtained from the Institut Pasteur, and from our cultures, did not attack either glucose or lactose when added); the nonproduction of indol in faintest trace when dissolved by added chloroform; finally, the impossibility of inducing the property of indol production in this organism by limiting its nutriment to proteids for several successive generations. Except for its marked motility it is impracticable, otherwise, to determine the organism from the various members of the colon and proteus group. For the same reason, and because of the incompleteness of most of the observations and experiments, so suddenly interrupted and *not yet* resumed, I can only allude to the validity of the claim made by Professor Sanarelli, that the bacillus icteroides is the *cause* of yellow fever. My failure to find it in control necropsies, with the uncertain exception of necropsy No. 6; the fact of its presence in 42 per cent of native cases, as evidenced by ourselves and by Professor Archinard,[1] of New Orleans, as well as that of its more constant presence in foreign cases in the *possibility* of 100 per cent, make this organism and the claim made for it a most important one, and while there may be some reasons to an admission of the claim it was the opinion of your commission, at the time of the interruption of its work, that it would require much time and labor in technical details to determine its true rôle in the pathogenesis of yellow fever.

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[1] A smaller per cent than if fresh culture examinations had been possible.

In conclusion I must state that our service is deeply obligated to Gen. Fitzhugh Lee, our consul-general at Havana, for counsel and advice and assistance at all times during our stay in Havana, for it was mainly due to his urbanity and gratefulness to the Spanish authorities that we were the recipients of so much courtesy from Captain-General Blanco and Secretary-General Congosto. The courtesies of General Pansano and of Colonel Marino, of the medical staff, were gratefully received. I must add my intense satisfaction in and thorough appreciation of the collaboratory work performed by P. A. Surg. H. D. Geddings, whose versatility was often evinced in the conduct of the work.

EUGENE WASDIN,
Surgeon, U. S. M. H. S.

WASHINGTON, D. C., *November 1, 1898.*

SIR: In presenting this preliminary report of the part taken by me in the investigation into the causes of yellow fever I would beg leave to enter briefly into a review of the question up to the time that I entered upon the work in New Orleans, and subsequently in Havana, Cuba, by your direction.

It is perfectly natural that a disease so well marked in its gross pathology and clinical history should, from a very early time, have afforded a field for minute investigation long before the time that the discoveries of Pasteur, Koch, and others changed the "germ theory" of disease into a system. With the advent of means of more correct investigation, with the discoveries of the specific cause of other infectious diseases as a guide, it was perfectly natural that a disease at once so peculiar and possessing so much interest for a large portion of the Western Hemisphere should form the subject of devoted study both in the United States and in Europe.

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[1] Personal statement of a large per cent.

The alleged discoveries of Babes, Gibier, Domingos Friere, Carmona y Valle, and others have passed into almost oblivion, after having excited acrimonious controversy and having been proved to be largely errors of interpretation, due mainly to faulty laboratory technique. The labors of Sternberg were arduous, systematic, and had as a result the clearing away of many erroneous impressions, and of inviting and fixing attention on the stomach, liver, and upper portion of the intestinal tract as the probable field of future research. In the meantime much labor had been expended upon the study of the micro-organisms of the normal intestinal canal, with the result that the subject was found to be one of vast dimensions and involving at every turn the elucidation of new problems and bringing to light heretofore small but most important differences. As an instance of this, and as pregnant with the most important facts, has been the study of the bacillus coli communis, for a long time considered as a single, well-defined, normal, and harmless denizen of the intestinal canal of man and most of the lower animals. But the researches of Booker and others demonstrated that it would be impossible longer to consider this organism as a single species, and that it must be considered one of a great group, possessing many characteristics in common, but at the same time presenting many points of difference, and these points not altogether morphological or cultural, but chemical and consisting in many instances in their behavior to reagents and media and in the chemistry of the products of their growth. It was notably the constant occurrence of organisms of this group which has led to most of the announcements of the discovery of the specific organism of yellow fever; discoveries which, however, did not withstand the scrutiny to which such alleged discoveries must ever be subjected.

At the conclusion of Sternberg's investigations the organism which had most attracted his attention was one isolated in Havana, possessing some of the characteristics as then known and considered of the bacillus coli communis but lacking others, which was pathogenic to animals, and which he designated as "bacillus X."

In 1897 there were presented at the Institut Pasteur in Paris two claims to the discovery of the specific organism of yellow fever, one from Havelburg, of Rio de Janeiro, Brazil, the other from Professor Sanarelli, of the University of Montevideo, both trained observers and both pupils of the institute. Their claims were widely different, and it was obvious that one of the two claims must be rejected. This was not a matter of difficulty. Investigation showed that Havelburg had added one more to the number of those whose differentiation of the colon bacillus had not been sufficiently minute and painstaking. The claims of Sanarelli were more intricate. His theory of infection was new and elaborate, but unfortunately the number of cases in which his alleged bacillus icteroides was found was only slightly over 50 per cent.

Such was the status of the yellow fever question when I was ordered by you in October, 1897, to join P. A. Surg. Eugene Wasdin, United States Marine-Hospital Service, in New Orleans, and jointly with him to continue investigations into the etiology of the disease. On arriving in that city I found that Dr. Wasdin had collected material from numerous necropsies and there was no lack of material. Our investigations were made in the bacteriological laboratory of the medical department of Tulane University, and we received much aid and many courtesies from Prof. P. E. Archinard, who at the time was engaged on the same subject. Very early it became evident that the published descriptions of Sanarelli as to the cultural appearances of his organism were vague. indefinite, and somewhat misleading. Always associated with the colon bacillus, it was a matter of great difficulty, often of impossibility, to differentiate it from that organism. Resembling it in many particulars, it lacked certain of its characteristics and possessed others of its own. Finally it was agreed that before an organism should be considered as that of Sanarelli it should have the following well-marked characteristics:

1. *Form.*—A small, rather fine bacillus, with rounded ends and no tendency to fusiform shape, 1 to 2 micromillimeters in length and about one-fourth as broad as long, occurring singly or in pairs, but never forming long chains from culture on solid media.

2. *Motility.*—Very actively motile, with individual organisms, making decided excursions, or translations, across the field of the microscope. (In this particular the bacillus icteroides of Sanarelli differs essentially from the colon bacillus, which, while motile, is sluggishly so, while the bacillus icteroides is fully as motile, or even more so, than the bacillus typhosus.)

3. *Gas production.*—In 2 per cent lactose bouillon, not previously treated by the colon bacillus, an amount of gas production not exceeding, as compared with the colon bacillus, the proportion of 1–4. In lactose and glucose bouillon, the muscle-sugar being destroyed prior to the addition of the lactose and glucose by the growth of colon bacillus, *there is absolutely no production of gas.* (This is in great contrast with the colon bacillus, which produces a fermentation in both lactose and glucose bouillon, with abundant évolution of gases, having nearly or quite a definite chemical composition.)

4. *Production of acid.*—In litmus peptone solution a slight production of acid. (This is in marked contrast to the colon bacillus and the bacillus "X" of Sternberg, in which the production of acid is very marked, and much in excess of that of Sanarelli.)

5. *Production of indol.*—The bacillus icteroides of Sanarelli, planted in Dunham's peptone solution, after twenty-four hours gives absolutely no production of indol upon the addition of dilute sulphuric acid and sodium nitrite. (This is in specially marked contrast to both the colon bacillus and the bacillus "X" of Sternberg, the production of indol in the latter being very abundant and well marked.)

6. The bacillus icteroides of Sanarelli does not coagulate milk. Specimens from various sources have been kept under observation in milk for as much as sixty days. (Various members of the colon group differ much in the length of time required to produce coagulation of milk. In some, the change is produced in twenty-four hours; in some which have been under observation nineteen days have elapsed before the change was complete.)

It is believed that these differences fully establish the fact that the bacillus icteroides of Sanarelli, while bearing a general resemblance to the colon group in morphology and cultural appearances, differs from it widely in the products of its growth and in its production of toxins.

As I have before said, much material was accumulated in New Orleans and much time was spent in the investigation of the organs and fluids from the bodies dead of yellow fever. Special attention was also given to the study for comparative purposes of cultures of the bacillus icteroides of Sanarelli, the bacillus "X" of Sternberg, and the ordinary colon bacillus. It can be safely said that the bacillus icteroides was found in a larger percentage of cases than had been claimed by Sanarelli in his series (58 per cent). A culture which possessed much interest was one which Dr. Wasdin had isolated from the blood of a living yellow fever patient at the detention camp at Fontainebleau, Miss., and which we always referred to in conversation as "bacillus Goodrich." Subsequently its identity with the bacillus of Sanarelli was almost incontestably proved, so to Dr. Wasdin belongs the credit of having isolated and proved the first bacillus icteroides (Sanarelli) found in a genuine case of yellow fever on the North American continent.

About the middle of November, as the laboratory of the college would be required in a few days for the instruction of students, and a sufficient number of cultures from various sources having been collected, it was decided to suspend the investigations in New Orleans, and by order of the President, Dr. Wasdin and I proceeded to Havana, island of Cuba, there to continue our investigations into the etiology of yellow fever. The season of the year was a little unfortunate, as, owing to the almost entire cessation of immigration into the island on account of the war, there was very little fever in the city, and the strained political relations existing between the United States and Spain, it was difficult to get access to the various military hospitals of the city, in spite of official promises. The time, however, was by no means wasted. A laboratory was established in the same building with the United States consulate, and here the cultures collected in New Orleans were systematically studied, and such material as could be acquired in Havana was at the same time investigated. Unfortunately the New Orleans cultures had suffered from transportation and from delay in getting our work started, so they were comparatively few in number. The results, however, may be stated in brief as follows:

	Examined.	Positive.	Negative.
Cultures from—			
Spleen	2	2	0
Liver	8	6	2
Kidney	1	1	0
Blood	1	1	0
Havana cultures from blood	4	3	1
Total	16	13	3

NOTE.—The following is offered in explanation of the above results: There were originally 24 cultures secured in New Orleans and carried to Havana. On arrival there it was found that some had been broken in transportation; some had perished from drying, and all of these were rejected and no work was done on them in Havana. Surgeon Wasdin has also called my attention to the fact that the results in one case, Necropsy No. 18, were not quite conclusive and must, to a certain extent, be reworked.

Making a percentage of 76.93, in which the organisms described by Sanarelli was found. Of course it would have been desirable to have had a larger number of cases, especially in Havana, but I think it will be conceded that a small number of cases carefully and exhaustively studied have more scientific value than a large number more cursorily examined.

Experiments had been begun upon the toxins of the bacillus icteroides, both precipitated and liquid, when it became necessary to suspend the work in Havana and to return to the United States on the 15th of March, 1898, since which time further investigation has been prevented by other duties in connection with epidemic work in the Southern States.

It is here necessary to say a few words in connection with the claim of identity of the bacillus icteroides of Sanarelli and the bacillus "X" of Sternberg, which has recently been made. It is inconceivable to my mind how such a claim can be sustained by anyone who has carefully studied and differentiated the two organisms. The bacillus "X" is coarser, longer, and stouter than the bacillus icteroides; originally quite motile when isolated in Havana several years ago, it is now an organism, hardly as motile as the ordinary colon bacillus; in its growth it produces fermentation in both lactose and glucose agar, with a gaseous product quite similar in composition to the products of the colon bacillus; it produces acid in its growth; its production of indol is well marked and excessive, and lastly it readily coagulates milk. Indeed it would seem that the bacillus "X" is simply and solely a well marked and accentuated colon bacillus. It is pathogenic, to be sure, for rabbits, guinea pigs, and other of the lower animals, but the time has long since passed when the colon bacillus can be considered as harmless and nonpathogenic.

It has also been objected that the bacillus icteroides too closely simulates the colon bacillus. To this it can only be said that in its characteristics of growth, as previously detailed in this article, there is a wide difference, nor is its similarity nearly so great as is that of the bacillus typhosus to the bacillus coli communis. The bacillus icteroides (Sanarelli) produces toxins, precipitable by ammonium sulphate, of well-marked intensity and potency, much more so than the toxins precipitated from bacillus "X" and ordinary colon bacillus.

The agglutination and arrest of motility experiments of Archinard and Woodson would seem to make the argument in favor of the pathogenicity of the bacillus icteroides all the stronger.

In concluding this preliminary and independent report which would indicate that the bacillus icteroides of Sanarelli is the specific agent in the causation of yellow fever, I would beg to recommend that opportunity be given for further experimentation on lower animals with its toxins, and with cultures if necessary, and that both be tested in connection with the antiamaryllic serum prepared according to the methods of Sanarelli.

Very respectfully,
H. D. GEDDINGS,
Passed Assistant Surgeon, U. S. M. H. S.

APPENDIX C.

REPORT OF TESTS MADE IN LOUISIANA IN THE USE OF PROFESSOR SANARELLI'S SERUM ANTIAMARYLIC AS A CURATIVE AGENT IN YELLOW FEVER.[1]

SIR: Under your instructions of September 26, 1898, to proceed to New Orleans, La., to endeavor to obtain cases of yellow fever in which to use the serum, I called upon the authorities of the Charity Hospital on October 1 and upon those in charge of Touro Infirmary in that city, and made known to them your earnest desire to have granted us the privilege of visiting cases of this disease in those institutions and of using the serum in those we thought suitable, this to be done only in consultation with the attending physician.

Prof. Ernest Lewis, vice-president of the board of regents of the Charity Hospital, after consultation with the superintendent of the institution, informed me that it was thought best to refuse your request on the ground that a test of the same serum, presented to the institution by Professor Sanarelli, was then in process, and that the limited number of cases in hospital scarcely furnished material for this test.

The authorities at the Touro Infirmary, especially Dr. Loeber, promised every facility for the use of the serum, manifesting a lively interest in the subject. At the same time they informed me that a definitely marked case of yellow fever was very rare in their hospital; that the prevailing type was so poorly marked, so slightly developed, that often it was found necessary to rely upon the fact of the presence of the disease in the community for a diagnosis. All such cases were treated very tentatively, scarcely any medicine being demanded; and in these it was thought there could be no definite results gained from serum exhibition, since they invariably recovered. Such were the cases then on hand. But I was promised instant notification of any admission of a serious type, and preparation was made to respond to such calls.

Consultation with Surgeon Carter, senior surgeon at New Orleans, on October 8, no suitable cases having been admitted to the Touro Infirmary, decided me to seek at Wilson, La., then generally infected, cases in which to test the prophylactic influence of the serum, and I proceeded there on that date. In this village of some 600 people I found the majority of the population sick or convalescent from a very mild type of fever, so much so that there seemed but little evidence of alarm. Through the courtesy of Acting Assistant Surgeon Bland, U. S. M. H. S., I saw a number of these cases, and he and other local physicians soon acquainted the people with the object of my visit. There was evidence of an indisposition to be "experimented" upon and many declined "the South American treatment." Of those who had been exposed, and who would probably develop the disease, there were 3 or 4 who expressed a disposition to submit to the prophylaxis, but they invariably asked for a guaranty, and when this could not be given they hesitated between the unknown remedy and the light type of the disease.

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[1] Reprint from Public Health Reports, November 25, 1898.

However, 2 cases of tolerably well-developed yellow fever were found willing to receive the serum treatment, and these are detailed below. In the second case the use of the serum was followed by such annoying urticarious erythema, especially after the second injection, that the apprehensions of the family were aroused, and the fact of the new treatment having produced symptoms not seen in any other cases, and of so serious an appearance, immediately became the subject of general comment, and I quickly found the serum relieved of all sympathy and invested with unknown possibilities for harm. I could get no consent to its prophylactic use.

At this time advice from Surgeon Carter directed me to Baton Rouge, La., where fever was then very rapidly spreading, and by invitation of Dr. C. McRea I visited that city on October 12, meeting and discussing with a large number of the physicians the probability of being able to use the serum. There was an expression of the liveliest interest in the subject and a disposition to render me aid, but a general conviction that they were scarcely warranted in advising the use of the serum in view of the very simple nature of the prevailing disease. In those cases developing more serious symptoms it was not deemed best to rely upon the serum. Hoping that cases might have occurred in the Touro Infirmary at New Orleans I returned to that city, and although there had been and were none suitable in that institution, I had the opportunity to see one at the United States Marine Hospital under the care of Dr. Faget. This is detailed below:

Case No. 1.—Robert Anderson; aged 50 years; a vigorous man, was taken sick at 10 p. m., October 8, 1898, with intense pain in back and limbs and a severe rigor, followed by high fever. When seen at 4 p. m. of the 9th, in consultation with Dr. Bland, the typical facies, pains and commencing icterus left no doubt that he had succumbed to the infection to which he had been freely exposed. Thus far only a mild mercurial had been prescribed, and with his consent the antiamarylic serum was used. At 6.15 p. m., 10 c. c. of serum were injected into the connective tissues of the loin; pulse 84, temperature 38.7°; much congestion of vessels of skin of face. Temperature to be taken every two hours as nearly as practicable.

At 9 p. m., temperature 39°, pulse 86, more marked flushing of the face and some sweating; at 11 p. m., temperature 38.8°, pulse 84, semi-delirious and perspiring very freely, urine free; at 1 a. m., October 10, temperature 38.6°, pulse 81, sleeping; at 3 a. m., temperature 38.4°, pulse 78, quiet; at 6 a. m., temperature 38.1°, pulse 76, urine free; at 8 a. m., temperature 37.8°, pulse 66, urine free; at 9 a. m., 10 c. c. of serum were injected into the connective tissue of loin; at 10 a. m., temperature 37.6°, pulse 70, congestion of face; at 3.40 p. m., temperature 38.3°, pulse 78, sweating profusely; at 5.45 p. m., temperature, 38.5°, pulse 78, urine free; at 7 p. m., temperature 38.6°, pulse 78; at 9.30 p. m., temperature 38.5°, pulse 74, restless; at 11 p. m., temperature 38.5°, pulse 72, slept one and one-half hours; at 1 a. m., October 11, temperature 38.3°, pulse 74, urine free; at 3 a. m., temperature 38.3°, pulse 73, sleeping; at 5.20 a. m., temperature 38.6°, pulse 75, feeling weak; at 7.10 a. m., temperature 37.8°, pulse 70; at 9 a. m., temperature 37.7°, pulse 68, injected serum 8 c. c.; at 7 p. m.,

APPENDIX D.

EFFORT TO TEST THE "SERUM ANTIAMARYLIC.

SPECIAL REPORT UPON THE EFFORT TO TEST IN SUITABLE CASES THE "SERUM ANTIAMARYLIC," DONATED TO THE UNITED STATES BY PROFESSOR SANARELLI, OF THE UNIVERSITY OF MONTEVIDEO, URUGUAY, WITH THE REQUEST THAT IT BE TESTED AT THE EARLIEST OPPORTUNITY IN SUITABLE CASES OF YELLOW FEVER.[1]

SIR: Pursuant to your instructions of August 20, 1898, to proceed to Santiago de Cuba for the purpose of testing the serum in suitable cases, both as a curative and as a prophylatic agent, I did so at my earliest opportunity, arriving in that city on August 25. Consultation with the military officials of our Government in command convinced me that the rumors prevalent in the United States of the malarial character of the prevailing fever in Santiago, rather than yellow fever, was correct. The officials of the city declared that there was no yellow fever in Santiago; therefore I refrained from visiting the city hospitals, because of the consumption of time and the inadvisability of a difference of opinion as to diagnosis in any possible cases seen there. However, the surgeon-in-chief of the military commandant of the province of Santiago assured me of the presence of the disease, as reported to him by his subordinate officers, and gave me carte blanche to enter the hospitals at both Siboney and on the island in the bay set apart for the purpose of a yellow fever camp. Owing to the rapidly progressing discontinuance of the camp at Siboney I took up my residence at the island hospital. A careful scrutiny of the number of convalescents there, and an inspection of their clinical histories, especially in regard to the pulse and temperature tracings, convinced me that while there was, in numerous cases, a condition resembling yellow fever, yet the pulse and thermographs did not fulfill the demands as enunciated by J. C. Faget;[2] that, while the pulse tracings were generally low, there was an absence of the typical "want of coordination" seen in an *ascending* or *stationary* fever at its acme, together with a *falling* pulse. There was much food for reflection, and I was finally convinced that in all of these cases, showing an intermitting type of fever, and most of them an enlarged spleen and tender liver, a malarial intoxication was present. Yet could the slow pulse, spongy gums, yellowish (not pronounced) skin and eyes, skin extravasations, depend upon yellow fever infection? I had reason to question the statement of "albumen in the urine" in some cases, since I was led to doubt the competency of the analyst. A continued study of these facts and of the cases arriving of so-called yellow fever led me to the conclusion that the *ensemble* of symptoms which had been so freely thus diagnosed was due to a very general condition of incipient or developing scorbutus, upon which there had become implanted a malarial toxæmia. To me this seemed to develop a condition of serious danger but little inferior to yellow fever itself. At no time did I see a case which warranted the use of the curative serum, since the enlarged spleens and other evidences of malarial infection, even if I had accepted the dictum of those in charge of the hospital, would, under Sanarelli's direction, have gone far to negative the results of its use. Under such circumstances I deemed it my duty to acquaint you with the conditions existing, especially since I had, before visiting this hospital and examining the patients, reported to you the favorable opportunity to fulfill your wishes in regard to this serum, as it was presented to me by the authorities.

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[1] Reprint from Public Health Reports, November 18, 1898.

[2] Monographie sur le type et la specificité, de la Fiévre Jaune, 1875.

In differing from the opinion of the officials of this hospital, I must express my grateful appreciation of their uniform courtesy to me at all times, and of the interest there was manifested in the work committed to my charge.

It is but right to say that every official courtesy was extended by Generals Lawton and Wood, and especially by Colonel Havard, the surgeon-in-chief, of the military forces occupying the province of Santiago de Cuba.

Respectfully, yours,

EUGENE WASDIN,
Surgeon, U. S. M. H. S.

APPENDIX E.

HAVANA, CUBA, *March 3, 1899.*

SIR: I have the honor to request that you will allow us to state that in regard to the production of gas through the fermentation of sugars in bouillon the conclusion advanced by us in our preliminary report is at fault, in that we state that the bacillus of Sanarelli does not ferment glucose with the production of gas.

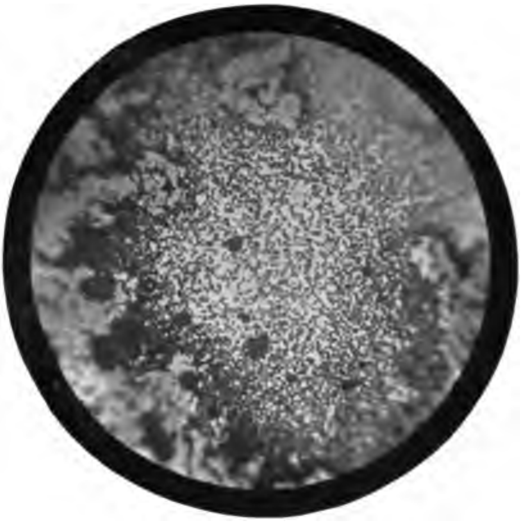
That conclusion was based upon observations actually made, the action of bacillus icteroides being noted in comparison with each organism isolated. Upon our return to this city the observation was found to have been at fault, since all examples of bacillus Sanarelli now give the production of gas with glucose. Most earnest effort was made to discover the source of this error of observation in order to correct it, and to ascertain its influence upon the other statements of our preliminary report. It suffices now to say that the fault of observation was based upon a fault of technique in the manufacture of our sugar media. This arose from the habitual use of the "Kny-Scherer" steam sterilizer, the lowest temperature in which is much too high for use in sterilizing these media. Recent experiment has demonstrated that the exposure of these sugar bouillons to the temperature of the "Arnold" sterilizer but for a short time is sufficient to cause a molecular change in the sugar, and that the usual method of sterilizing on three successive days, if done in the "Kny" cylinder, even carefully, will result in serious change in the media. Glucose under these circumstances shows less gas production, with the appropriate organism until finally this ceases. Lactose is first inverted, the organism producing now as much gas as in a glucose medium, but further heating changes it so that the production of gas ceases, although the organism, still grows freely therein. These facts depend upon the change of a part of the sugar into caramel, for in bouillon to which a saturated solution of caramel has been added in sufficient quantity, about 35 per cent, and in which Fehlings's solution shows considerable free sugar, the bacillus icteroides grows abundantly, but does not ferment the unchanged sugar. Upon the establishment of our laboratory here the lack of a good gas supply caused us to use the high-pressure sterilizer entirely, and it was more than easy to allow overheating, and since this was done with this medium in thin Smith's tubes, the change in color of the medium was not appreciated. In justice to Professor Sanarelli and other observers, and to place our report on a correct basis, we think this correction should be made at once, and not await our final report.

I have revised the work involved in the preliminary statement, and find that it is not in question otherwise.

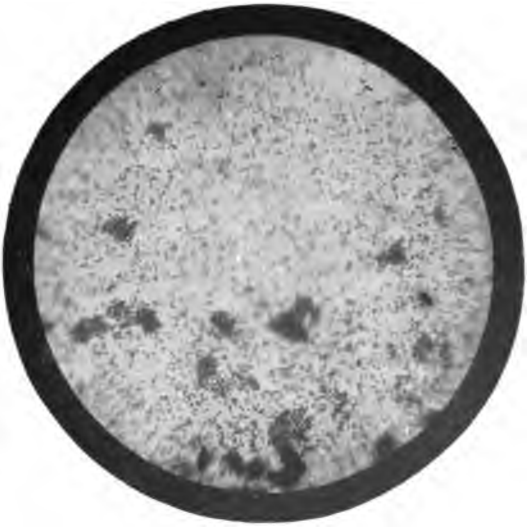
Most respectfully,

EUGENE WASDIN,
Surgeon, U. S. M. H. S.

The SUPERVISING SURGEON-GENERAL,
U. S. Marine-Hospital Service.



B. ICTEROIDES FROM AUTOPSY NO. 18, NEW ORLEANS, SHOWING AGGLUTINATION PRODUCED BY EXPOSURE OF 6 DAYS TO SERUM ANTIAMARYLL. ×500.



B. ICTEROIDES, FROM CULTURE ON AGAR-AGAR, 48 HOURS OLD. ×500.

#7

#8

Treasury Department.—U. S. Marine-Hospital Service.

REPORT

OF THE

COMMISSION APPOINTED BY THE SECRETARY OF THE TREASURY

FOR THE

INVESTIGATION OF PLAGUE IN SAN FRANCISCO,

UNDER INSTRUCTIONS FROM

THE SURGEON-GENERAL, MARINE-HOSPITAL SERVICE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1901.

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LETTER OF APPOINTMENT.

TREASURY DEPARTMENT,
Washington, January 19, 1901.

GENTLEMEN: You are hereby appointed official commissioners from this Department for the purpose of ascertaining the existence or non-existence of bubonic plague in the city of San Francisco, Cal., under such instructions as shall be furnished you by the Surgeon-General of the United States Marine-Hospital Service.

Respectfully,

L. J. GAGE, *Secretary.*

Prof. SIMON FLEXNER,
University of Pennsylvania.
Prof. F. G. NOVY,
University of Michigan.
Prof. L. F. BARKER,
University of Chicago.

INSTRUCTIONS.

TREASURY DEPARTMENT,
OFFICE OF THE SUPERVISING SURGEON-GENERAL,
MARINE-HOSPITAL SERVICE,
Washington, January 23, 1901.

SIR: I inclose herewith a letter signed by the honorable the Secretary of the Treasury, appointing a special commission of the Treasury Department for the purpose of ascertaining the existence or nonexistence of bubonic plague in San Francisco or other ports or places in the State of California, under such instructions as shall be furnished by the Surgeon-General of the United States Marine-Hospital Service.

The commission is composed as follows: Prof. Simon Flexner, University of Pennsylvania, chairman; Prof. F. G. Novy, University of Michigan; Prof. L. F. Barker, University of Chicago, recorder.

A copy of the Secretary's letter has been furnished to the other members of the commission.

In accordance with the letter of the honorable the Secretary of the Treasury, you are directed to proceed, at the earliest practicable date, to San Francisco, where the commission will hold its first meeting at the Occidental Hotel.

You are informed that the bubonic plague has been reported to exist in San Francisco, and its existence has also been strenuously denied, and you are directed to place yourself in communication with the proper local authorities, with a view to obtaining facilities for the examination of cases, either deceased or living, suspected of being infected with this disease. You are further informed that it is the desire of this Bureau that your investigations should be entirely unprejudiced and independent. It is left for the commission to determine a proper location for pursuing its investigations, and it will meet with the approval of the Bureau if accommodations can be obtained at one of the laboratories connected with one of the institutions of learning in San Francisco.

At such time as shall seem appropriate the commission will call and pay their respects to the governor of the State and to the mayor of San Francisco.

A full report of your procedures and of your findings will be prepared by the recorder, signed by all the members of the commission, and the same transmitted to the Bureau immediately upon reaching a conclusion. The chairman of the commission, when a conclusion has been reached, will telegraph the same briefly to the Bureau, and your findings will not be otherwise given out until authorized by the Bureau. To this end you will await final orders from the Bureau before departure from San Francisco.

Vouchers are inclosed herewith upon which your accounts should be rendered for the expenditures incurred under the terms of the letter of the Secretary of January 19. If other expenditures become necessary, there are two courses to be pursued.

First. The small expenditures are to be paid by yourself, an accurate account of which should be kept, and a bill rendered by yourself for same. Receipts should be taken in all cases where possible and attached to the bill as subvouchers.

Second. Expenditures or expenses involving larger amounts. Should these become necessary you are requested to telegraph the Bureau, stating the approximate amounts and the purposes for which the expenditures are necessary, and receiving instructions from the Bureau relative thereto.

All expenditures other than those covered by the letter of the Secretary of January 19 shall be incurred only by the chairman of the commission.

You are requested, at least two or three times a week, to make a brief written report of the status of your investigations, not necessarily technical, in order that the Bureau may be informed as to the progress of the work of the commission.

Respectfully,
WALTER WYMAN,
Surgeon-General Marine-Hospital Service.

Prof. SIMON FLEXNER,
University of Pennsylvania, Philadelphia, Pa.

REPORT OF COMMISSION.

San Francisco, Cal., *February 26, 1901.*

Sir: The special commission appointed by the honorable the Secretary of the Treasury for the purpose of ascertaining the existence or nonexistence of bubonic plague in San Francisco or other ports or places in the State of California, under instructions furnished by the Surgeon-General of the United States Marine-Hospital Service, begs leave to submit the following report:

In accordance with instructions received, the members of the commission proceeded as early as possible to San Francisco, one of them (Dr. Barker) arriving on Friday, January 25, 1901, the other two (Dr. Flexner and Dr. Novy) on Sunday, January 27.

The first formal meeting of the commission was held at the Occidental Hotel shortly after the arrival of all the members. At this meeting it was decided, in accordance with your instructions, to call and pay our respects to the honorable the governor of the State, to place ourselves in communication with the local authorities in order to obtain facilities for the examination of the sick and dead in Chinatown, or elsewhere should suspected cases arise, and to arrange for a laboratory in which pathological and bacteriological examinations could be undertaken.

Owing to the miscarriage of a letter sent to the commission by the honorable the governor of the State, the call of your commissioners upon him was delayed until Saturday, February 16. On this date, however, they had the privilege of paying their respects to the governor and of informing him of their orders. The governor received your commissioners most courteously and stated that the authorities in California desired to facilitate by every means in their power the investigation concerned.

A call was also made upon the mayor of the city of San Francisco and upon the president of the city board of health, both of whom offered to aid, in any way possible to them, the work of your commissioners. The city board of health supplied the commission with a map of Chinatown, on which were charted the location of cases which the board had examined and regarded as plague.

During the first fifteen days of our visit a bureau was opened in the Occidental Hotel; the commission met at 11 o'clock daily, and it was announced in the press that its members would be glad to confer with anyone who had information to give with regard to the existence or nonexistence of plague in the city. In addition, letters were sent to a number of physicians in town requesting an interview. The majority of those written to responded; opinions were divided, some of the physicians being confident that plague existed, others being sure that the disease was not here. The establishment of this bureau proved to be of great service, not so much in affording us information about plague as in putting us into relation with the medical and business interests of the city. Through it a plan of work became easy to formulate; through it we learned how to gain access to the sick and dead Chinese and how to proceed without exciting the opposition or suspicion of those among whom we were to work.

The representatives of the principal commercial interests of the city of San Francisco, including the Merchants' Association, the Manufacturers and Producers' Association, the Board of Trade, the Pacific Coast Jobbers and Manufacturers' Association, the Chamber of Commerce, the Pacific Mail Steamship Company, and the Southern Pacific Railway, called upon the commission, welcomed them to California, and offered their aid. Through the courtesy of Colonel Mendel, room 161 of the city hall, previously used as a license office, was put at the disposal of the commission. It was fitted out as a laboratory, the outfit being purchased new in San Francisco.

INSPECTIONS OF THE CHINESE SICK AND DEAD.

The attorney of the Chinese Consolidated Benevolent Associations (ordinarily known as the Chinese Six Companies) advised the Chinese to cooperate with the commission. As a result, proclamations were issued ordering the Chinese to report all cases of sickness and death, no matter what the cause, to the offices of the Chinese Six Companies in order that daily inspections might be made. Mr. Wong Chung, the secretary of the Six Companies, accompanied a member of the commission (Barker) daily to each house whence a report had been made, aided in finding the cases, acted as interpreter, and assisted in obtaining the necessary histories. It is believed by the members of the commission that the Chinese Six Companies acted in good faith and that they made every attempt to give access to the sick. Certain cases of sickness, it is true, were not reported and were not known of until the dead bodies were found, but this, it is believed, was due to negligence on the part of the Chinese concerned rather than to any attempt at concealment.

The daily inspections of the sick and dead permitted of observations relative to the mode of life of the people in the 14 blocks of San Francisco which make up "Chinatown." These observations were extended by special trips of inspection under the guidance of officers of the city detective force and by numerous independent trips of inspection made by your commissioners.

The dwellings of the poorer classes of Chinese were found to be here, as they seem to be everywhere, shockingly unsanitary. In places there is marked overcrowding; the rooms are small; they are often entirely devoid of light or means of ventilation, and nearly always insufficiently lighted and ventilated; many of them are filthy; some of them, especially those situated in basements, are damp and emit a foul stench. These faults in sanitation are not confined to the tenement houses of the Chinese; on the contrary, in the rear of, or over or under, some of the more pretentious business buildings are to be found sleeping and living apartments which are most objectionable from a sanitary point of view.

The Chinese in San Francisco are, however, in many respects much better off than are their countrymen in great native centers like Canton or even than those in a city like Hongkong. There is almost an entire absence of the utter destitution met with among many of the Chinese in Asia. The Chinese in San Francisco are, on the whole, very well fed, for wages are high and food is abundant and cheap. They are also well clothed as a rule, and particular emphasis is to be laid upon the fact that the Chinese here wear shoes, stockings, and trousers, since it is believed by many that the bare legs and feet of the Chinese in Hongkong and Canton had much to do with the frequency of infection with plague in those places.

A large percentage of the Chinese in San Francisco, it is said, smoke opium. There are a number of Chinese prostitutes, but inspection of the quarters occupied by the latter would indicate that the rooms in which they live are on the whole more wholesome as regards air space, light, ventilation, and cleanliness than those of the other inhabitants of the district.

On Wednesday, February 6, 1901, systematic daily rounds of visits were made by one of the commissioners in company of Mr. Wong Chung to the rooms of the sick as reported each day to the offices of the Chinese Six Companies. Rapid clinical examinations were made and notes kept of the results. A number of the cases met with were obviously instances of advanced tuberculosis; others were affected with various chronic diseases. Such cases, being of no interest for the investigation, were visited only once. When patients were found who presented symptoms which were suggestive of plague, a careful examination was made. In doubtful cases the first visit was followed by others and the progress of the illness carefully watched. These regular visits of daily inspection were maintained until February 16, 1901, during which period a sufficient number of instances had been observed to permit your commissioners to conclude beyond possible doubt that cases of bubonic plague were occurring among the Chinese.

Inspections of the dead in Chinatown were also made daily by the same member of the commission, beginning February 5, 1901. Access to the dead was gained in two ways. In the first place the assistant city physician, Dr. F. P. Wilson, makes the rounds of the undertaking establishments in Chinatown each forenoon. He inspects the bodies of the dead, and where necessary advises a pathological and bacteriological examination by Dr. Kellogg, the bacteriologist of the city board of health. Permission was obtained from these gentlemen for the making of simultaneous and independent inspections and of pathological and bacteriological examinations by the commission.

A second mode of access to the dead was that afforded by the reports made by the Chinese directly to the offices of the Six Companies. By this mode it was in some instances possible to learn of the death of individuals and to make inspections of bodies before the city officials were informed of them.

From February 5 to February 16, 13 dead Chinese were inspected as follows:

Death 1 (inspected February 5).—Chun Ah Chou, age 44, actor, died this morning in Washington Street Theater. Body well nourished; two or three dark bluish spots on legs (possible hemorrhages). On palpation of the neck, axillæ, and groins some enlargement of the lymphatic glands of the left groin was made out, though nothing corresponding to an outspoken bubo was visible. Inspecting commissioner advised a pathological and bacteriological examination in order to remove all doubt as to the nature of the case. The results proved the case to be one of infection with plague (*vide infra*—laboratory case 1).

Death 2 (inspected February 5).—Wong Koong Chin, elderly Chinese male, died at 6a Waverly place; history of dyspnœa and cyanosis for a long time before death. There is marked œdema of legs; no enlargement of lymphatic glands ascertainable on palpation. Death certificate signed by city physician as due to valvular disease of the heart. Case was not regarded as suspicious and no pathological or bacteriological examination was insisted upon.

Death 3 (inspected February 5).—Lee Kee, middle-age Chinaman, found dead at 917½ Stockton street. This man had been visited by members of the commission 2 nights before, the case having been reported to them as one suspected of being plague. Neither when seen during life nor on inspection after death was anything seen which pointed to infection with plague. No enlargement of lymphatic glands could be made out. A pathological and bacteriological examination was, however, deemed avisable for purposes of exclusion. The results as regards plague were negative (*vide infra*—laboratory case 2). The assistant city physician attributed the death to intestinal obstruction.

Death 4 (inspected February 6).—Fong Sha Song, coolie, age 56, found dead in "hall of tranquillity" at rear of 1111 Stockton street. No available history of condition *intra vitam;* body filthy; œdema of legs; no enlarged lymphatic glands; no visible hemorrhages; pathological and bacteriological examination advised for purposes of exclusion. Results negative as regards plague (*vide infra*—laboratory case 4). Death attributed by city physician to interstitial nephritis.

Death 5 (inspected February 6).—Lum Hong Yuen, died in room 15, third floor, at 28 Ross alley. Body found at Main Fook's undertaking establishment at 740 Pacific street. Through Mr. Wong Chung, the secretary of the Six Companies, a school-teacher who knew deceased stated that the man had been ill about three weeks; that he had been a cook and waiter in the Chinese Theater up to three weeks ago, when he quit work on account of chancre and bubo; that since then he has been in his own room in Ross alley; that four or five days before his death he was given medicine by a Chinese doctor for a chill; that said medicine was too strong for the patient, and that "his breathing stopped and he died."

On inspection of the body no evidence of chancre could be found; in the inguino-femoral region a large mass of swollen conglomerated lymphatic glands could be felt. The swelling was so like similar swellings previously observed in cases of plague in Hongkong and in India that the case was regarded as almost certainly one of plague. Pathological and bacteriological examinations were made at once; the results proved the correctness of the impression gained from inspection (*vide infra*—laboratory case 3).

Death 6 (inspected February 7).—Wong Chi Lui; age 45; cigar maker, who had worked at 418 Battery street; found dead at 18½ (21½) Waverly place. Through Mr. Wong Chung it was ascertained that the man had been ill for about two weeks, complaining of fever, loss of appetite, and general uneasiness. He had had pains in groins and lower abdomen, to which region a Chinese doctor had applied honey and salve. No history of venereal disease. For three or four days prior to death the man was unconscious. When chided by Mr. Wong Chung for not having reported the case earlier to the Six Companies, the brother of the deceased said he had not made a report because he had believed that the patient would soon be well.

On inspection and palpation a large mass of swollen glands was discovered in the left inguino-femoral region. It seemed likely that the case was one of plague and the friends of the deceased were notified that an examination of the body would be made immediately. The pathological and bacteriological examination established the death as one due to infection with bacillus pestis (*vide infra*—laboratory case 5).

Death 7 (inspected February 11).—Tom Shom; male; age 51; actor in Chinese Theater; room above theater at 814 Washington street, near room of late Chum Ah Chou (see death 1). This man was reported as ill to the Six Companies, and was examined clinically on Friday, February 8, by Dr. Barker, who obtained the following history: The man had been acting in the theater about two weeks before, although it had been stated that he had not been very well for from six to seven months previously. On February 4 he became seriously ill with fever and delirium. There has been some vomiting. The urine, as observed by the attendant, was described as brandy colored. He had a Chinese doctor in attendance, and his friends had not considered him ill enough to make a report to the Six Companies worth while. The man smoked about 50 cents' worth of opium daily. On clinical examination the patient was found lying upon his back in bed, with legs drawn up. He was in a state of semistupor. His pulse was 108, quick, rather full, but of low tension. The skin was hot and dry. Respiration, 20 to the minute. The face had an anxious expression. The tongue was coated in the middle. There was no palpable enlargement of the glands of the neck or axillæ, but in the right groin several slightly enlarged glands could be distinctly felt, and the patient, though his mind was partially clouded, winced decidedly when either groin was palpated. It was evident that the glands were quite tender. In the absence of urethral discharge, chancre, or evidence of local irritation in the lower extremities, the case was, on account of the local and general phenomena, regarded as one of plague. The skin was cleansed and a sterilized hypodermic needle introduced into the groin. A few drops of bloody fluid were withdrawn, presumably from one of the enlarged glands. It was difficult to be sure of this, however, as the patient could not be kept quiet while the needle was being inserted. No colonies of plague bacilli developed in the inoculated tube. The necropsy subsequently made indicated that the needle had failed to enter an enlarged gland.

The patient was seen on the following day, when his condition showed no change for the better. The pulse was 136 and feebler; the patient seemed in general weaker, and an unfavorable prognosis was made. The patient's friends were told that an injection of Yersin's serum offered the best chances for recovery, though they were also told that not much could be hoped from any treatment in the stage of the disease in which patient then was. The offer was refused. The man died on February 10, the next day.

The dead body was inspected on the morning of February 11. The body was in a state of firm rigor mortis, the limbs being strongly flexed. On breaking down the rigor mortis and palpating the glands in the groin, it was difficult to say positively that there was any enlargement of the lymphatic glands. In view of the enlargement distinctly made out during life and the clinical picture which had been observed, the death was believed to be one due to plague and a pathological and bacteriological examination undertaken. The results indicated clearly the existence of infection with B. pestis (*vide infra*—laboratory case 6).

Death 8 (inspected February 11).—Chung Moon Woo She, wife of Chung Toy Ding, living in a cellar at 27½ Waverley place. She had been seen clinically by inspecting commissioner on February 6, and also on February 9. When first seen clinically it was learned that she had been ill for three or four days, complaining of aching pains in ribs and other bones, headache, and loss of appetite. She had no cough. Two days before she had felt very chilly. On examination she was found to have slight fever; pulse 100; tongue slightly coated; examination of thorax and abdomen negative; careful palpation of cervical, axillary, cubital, inguino-femoral, and popliteal lymph glands revealed no enlargement or tenderness. When seen on February 9 the patient was found to have grown much worse; the pulse was 132, and quick; the temperature was higher, the tongue was dry, sordes were appearing upon the lips, and the woman was semistupid and moaning in bed. The next day, February 10, the patient died, and the body was inspected on the following morning. The house in which the body lay was filled with men, women, and children, friends of the deceased, all of whom objected strenuously to any examination of the body whatever. It was insisted upon, however, and finally, by promising that only one small cut would be made, permission for examination was granted. Amid an appalling outbreak of grief on the part of the friends, an incision was made in one groin, and as the glands embedded in the fat there showed no hemorrhage or enlargement no further examination was made. It is to be regretted in this case, where only one slight incision was allowable, that the spleen was not bacteriologically examined, as the case may have been one of general infection with B. pestis. At the time, however, in face of the strong protest made by the friends, it seemed wise, in order not to antagonize the Chinese too much and so perhaps interfere with the progress of the whole investigation, not to go further. The body was surrounded by quicklime and sublimate sheet, and burial was permitted by the board of health.

Death 9 (inspected February 12).—Foong Ah Fong, female; age 12; found dead at 747 Sacramento street (room No. 12), fourth floor. This little girl had been observed clinically on February 6, the first day of systematic clinical inspection. She gave a history of having caught a cold, followed by a headache and lack of appetite. She had complained of no chill or vomiting. Her pulse was 84, and her temperature only slightly above normal. She did not look very ill; the tongue was slightly coated; there was no palpable enlargement of lymphatic glands. As the splenic dullness was only slightly increased, and the mother of the child stated that the patient had been ill for fully two weeks, plague was not suspected. The case was looked upon as possibly a mild case of typhoid, and instructions were given to report to the Six Companies in case she got worse. She was not visited again during life. It was a surprise to hear of her death, and on inspecting the body, though no external signs of plague were visible, it was deemed advisable to make at least a bacteriological examination of the spleen. This was done, but under marked protest from the child's relatives. The result showed that the child was actually infected with B. pestis (*vide infra*—laboratory case 7).

Death 10 (inspected February 12).—Ung Ah Buck; age 45; found dead at Wing Hai's undertaking establishment, on Sacramento street. This man had been seen alive and examined by Dr. Barker on the previous day, who diagnosed the case, *intra vitam*, as one of cervical bubonic plague. When seen alive he was in a room upstairs in the rear of 921½ Dupont street, opposite St. Louis alley. The man was sitting up, but looked extremely ill. His face was pale, cyanotic, and anxious looking. His voice was very feeble, but his intelligence seemed almost unclouded, and he was able to carry on a conversation, though with difficulty, with the interpreter. The friends stated that he had at times wandered in his talk. He was under the care of Dr. Mather. The patient stated that he had been ill for two weeks. His neck had been swollen for one week, and he regarded the condition as quinsy. With the aid of a tongue depressor the throat was examined. The fauces were swollen and reddened, the swelling being very marked in the left side. The left palatine tonsil was much enlarged and showed on its surface a grayish white patch the size of a dime. The reddening in the throat was general, and there was less local injection than one ordinarily sees in diphtheria. The left side of the neck was brownish yellow, having been painted over with a solution of iodine. On inspection and palpation marked bulging was found. This seemed to be due to enlargement of the cervical lymphatic glands. The case was diagnosed as one of plague, with cervical bubo. The man died next day, and a complete autopsy was made by Dr. Flexner. The pathological examination showed typical lesions of plague, and the bacteriological examination made by Dr. Novy demonstrated the presence of B. pestis (*vide infra*—laboratory case 8).

Death 11 (inspected February 14).—Baby, 7 days old, found in undertaker's establishment on Clay street, having died at 717 Sacramento street. Advised making of cover-slip and cultures from umbilical stump and from spleen; reported negative as regards B. pestis.

Death 12 (inspected February 15).—Ow Ah Lane; male, age 55; coolie, who had worked at San Jose Junction, died at Kwang Chow "hospital" February 14, at 6 a. m. He had been ill for from six to seven months. No enlargement of lymph glands. Advised bacteriological examination of spleen. Reported negative as regards B. pestis.

Death 13 (inspected February 16).—Male; body found at Quong Fook's undertaking establishment. Slight swelling in right groin. Pathological examination negative as regards plague. No bacterological examination made.

It will be noticed that of the 13 deaths which came to our attention, occurring from February 5 to February 16, inclusive, 6 were undoubtedly due to infection with plague. A seventh (death No. 8) may have been a case of plague which went unrecognized. The 6 undoubted deaths from plague occurred during the eight days from February 5 to February 12, inclusive. During the days, February 13 to February 16, inclusive, no new cases of plague or deaths therefrom were encountered.

Two of the deaths from plague occurred in the Chinese Theater on Washington street. The other four cases occurred singly in different parts of Chinatown. The accompanying map shows the location of 6 cases observed by your commissioners and also of those which have previously been regarded as plague by the city board of health.

The study of cases during life and the inspection of bodies after death proves that it is often difficult and under certain circumstances impossible to make a diagnosis of plague, even post-mortem, without bacteriological examination. In outspoken bubonic cases there will be but little, if any, difficulty in diagnosis, either *intra vitam* or post-mortem, provided the observer has had sufficient experience with the disease, but in the absence of primary buboes, the unskilled observer will miss practically every case and even the practitioner who has had much experience with plague may be deceived. Your commissioners feel sure, from experience with plague in Hongkong, India, and San Francisco, that once it is established that plague exists among the Asiatics of a town, every Asiatic who has fever should be suspected as a case of infection with plague until the disease is proven to be other than plague and every dead body should be treated as a plague cadaver until bacteriological examination of glands, lungs, and spleen (including animal inoculation) has proven the absence from the body of the B. pestis. Only by such caution will it be possible to avoid missing actual plague cases.

In the following table are given the deaths per month occurring from all cases among the Chinese during the past four years as recorded by the city board of health. As data regarding the exact population of Chinatown at different times are not obtainable, it is difficult to institute comparisons of the mortality among the Chinese with that among the whites. It is obvious, however, that at no time during the past four years has the mortality rate among the Chinese increased to such an extent as to, in itself, cause alarm.

Mortality among Chinese of San Francisco, 1897–1901.

Months.	1897.	1898.	1899.	1900.	1901.	Months.	1897.	1898.	1899.	1900.	1901.
January	37	35	46	64	45	August	35	47	43	19	......
February	46	36	39	48	......	September	45	27	35	27	......
March	38	46	37	47	......	October	36	53	44	32	......
April	35	41	33	30	......	November	39	66	37	34	......
May	27	34	36	42	......	December	23	46	48	32	......
June	30	21	46	25	......						
July	39	25	34	38	......	Total	430	477	478	438	45

The pathological anatomy of the cases of bubonic plague met with in San Francisco.

1. Human cases.
2. Experimental inoculations.

In the study of the pathology of the cases of plague met with among the Chinese in San Francisco, a number of disadvantageous circumstances were contended with. In the first place, owing to the peculiar prejudices of this people, prejudices born especially of their religious beliefs and practices, permission for post-mortem examination is given with great reluctance. The opposition to all mutilation of the bodies of the dead is so great that consent for necropsies was obtained only after assurances that the examinations would be limited strictly to the actual necessities for the establishment of the diagnosis of the disease.

In the next place, there is no public mortuary in San Francisco to which the dead bodies were or could be carried. Such examinations as were made were conducted in the narrow limits of a dimly lighted alcove in an undertaker's shop or in the even worse habitations where the dead were found.

Under these circumstances, the post-mortem examinations left something to be desired on the score of completeness, although in every instance the important question whether death was caused by plague was answered definitely.

The majority of the dead did not exhibit well-marked buboes. Careful palpation usually was required in order to discover swellings and œdema of the groin. In all cases in which inguinal buboes were suspected or discovered incision was performed and the diseased glands and periglandular tissue, if present, removed.

With one exception (case 8) complete necropsies were not made. In all cases, however, the spleen was exposed and examined and parts removed. The tissues removed at necropsy were examined in three different ways.

1. Cultures upon agar-agar and cover-slips were made at once after removal.
2. The tissues were taken to the laboratory, where additional cultures and cover-slips were prepared and examined.
3. Guinea pigs were inoculated with portions of the tissues.

Finally portions of the tissue were placed in alcohol for future study.

HUMAN CASES.

Case 1.—Chom Ah Chou; necropsy February 5, 8 p. m. Examination was made in the presence of one of us (Flexner) by Dr. Kellogg. The examination consisted in exposing and removing the inguinal and femoral glands on both sides. Incisions were made deep into the subcutaneous tissue, extending from Poupart's ligament about one-third the length of the thigh. The tissues on the left side were swollen and œdematous; the œdema was sero-hemorrhagic in character, and the lymphatic glands were hemorrhagic and greatly swollen. On the right side the œdema was less marked, and the glands, while distinctly enlarged and reddened, were less altered than those of the left side. Sections of these glands showed them to be uniformly hemorrhagic and swollen and to contain frequently necroses visible to the naked eye.

The spleen was fully twice the normal size. It was softer than normal, the capsule was wrinkled, and the color deepened.

The further examination of these tissues was made after removal to the laboratory, and participated in by Drs. Barker and Novy. The examination consisted in—

(*a*) Study of cover-slips stained in anilin dyes and treated by Gram's method.

(*b*) Preparation of cultures upon agar-agar separately by each member of the commission.

(*c*) Inoculation of guinea pigs with portion of tissue from the glands and spleen.

(*d*) Preservation of tissues in alcohol for future study.

The examination of the cover-slips from the glands, periglandular tissue, and spleen showed large numbers of bacilli decolorizing by Gram's method and presenting the morphology of the B. pestis.

Case 2.—Lee Kee; necropsy February 5, 9 p. m., in the presence of Dr. Flexner, performed by Dr. Kellogg. No evidence of plague.

Case 3.—February 6, Lum Hong Yuen; autopsy made in Main Fook's undertaker shop; Drs. Kellogg, Novy, and Flexner present. Upon incision, the right groin from Poupart's ligament to the beginning of the middle third of the thigh, sero-hemorrhagic periglandular œdema and uniformly enlarged and reddened glands were found. The amount of fluid was considerable; although there was enlargement of all the glands, some of them reached to the size of a horse-chestnut. On section, these were of deep red color and soft consistence. Necroses were present.

The spleen was enlarged to fully double the normal size; it was softened and of a deep bluish red color.

Cultures and cover-slips were made at once by Dr. Novy and the excised tissues taken at once to the laboratory, where additional cultures were made, cover-slips examined, and animals inoculated.

The cover-slips showed large numbers of bacilli having the morphology and staining properties of B. pestis.

Case 4.—February 6, Fong Sha Shong; necropsy by Dr. Kellogg, in the presence of Drs. Novy and Flexner. No evidence of plague.

Case 5.—Wong Chi Lui, February 7; necropsy by Dr. Barker, 6 p. m. Drs. Novy and Kellogg present.

On inspection, there was a swelling in the inguino-femoral region, which, on incision, revealed enlarged glands about the saphenous opening and in the groin. The largest gland had the size of an English walnut and was of a dark reddish-brown color; it was soft and juicy in consistence and mottled with hemorrhages and grayish-white patches of necrosis. The less swollen glands were markedly injected and contained hemorrhages. Periglandular tissue was very œdematous, the fluid running freely from the incision. The spleen was about twice the normal size, soft, and friable.

Cultures were made at once by Dr. Novy and cover-slips about one hour later at the laboratory, where at the same time animals were inoculated with portions of the tissue. The cover-slips from the spleen and the glands showed bacilli presenting all the properties of B. pestis.

Case 6.—February 10, Tom Shom; necropsy by Dr. Kellogg, Drs. Barker and Novy being present.

There was a slight swelling in the right inguino-femoral region which, on incision, revealed slightly œdematous subcutaneous tissue, with slight enlargement of the glands. The largest gland had the size of a filbert, and its surface was dark and hemorrhagic; on section, it presented distinct hemorrhages; other glands were swollen, soft, juicy, and hemorrhagic. The spleen was enlarged, soft, and friable. The examination of the groin showed that the hypodermic puncture made for the withdrawal of fluid for diagnostic purposes during life had failed to enter a lymph gland.

Cover slips from the spleen and glands showed large numbers of bacilli having the characteristic properties of the B. pestis.

Case 7.—Foong Ah Fong, February 12; necropsy by Dr. Flexner, Dr. Barker present. The spleen only was examined; the organ was enlarged to about twice the normal size and was diminished in consistence. Cover-slips showed a very small number of bacilli of the size of B. pestis, although the characteristic polar staining was not observed. Cultures were made, and a portion of the spleen was introduced subcutaneously into a guinea pig.

Case 8.—Ung Ah Buck; autopsy February 12 at noon, at the undertaking shop of Wing Hai by Dr. Flexner, Drs. Novy, Barker, Kellogg, and Wilson being present. The left side of the face and neck presented a marked diffuse swelling, extending from the angle of the jaw backwards to the sterno-cleido-mastoid muscle and below, almost reaching the clavicle.

On incising this region the parotid gland was first reached; this organ presented a normal appearance. After dissecting away the parotid gland a group of greatly enlarged deep glands surrounding the carotid artery and jugular vein came into view. The periglandular tissue was infiltrated with bloody fluid and presented a sodden appearance. The enlarged glands and portions of the surrounding tissue were excised; the former were found to be swollen (several reaching the size of an English walnut) and to be wholly altered in appearance and consistence. In color they were deep purplish, and on incision a hemorrhagic fluid exuded. Opaque points of necrosis were also present.

The general subcutaneous fat was well developed; there was no general œdema. Peritoneum appeared smooth and glistening; there was no excess of fluid in abdominal cavity and the abdominal glands were not noticeably swollen. The spleen was enlarged to fully twice its normal size; it presented a purplish color and its consistence was diminished. The pleural cavities were dry. The lungs retracted moderately upon removal of the sternum. The lower lobes of the lungs were congested, but no consolidation was made out. No other abnormality was observed in the body.

The organs and tissues removed at this necropsy, consisting of the enlarged cervical glands and spleen, were taken to the laboratory, where cover-slips, cultures, and animal inoculations were made.

The cover-slips from the spleen showed large numbers of a bacillus having the morphology and staining properties of the B. pestis. The cover-slips from the glands differed in their appearance. In some instances there were present large numbers of bacilli similar to those in the spleen, together with a few diplococci or short chains of cocci. Other cover-slips showed, besides the organisms mentioned, a bacillus having the morphology of the B. diphtheriæ.

EXPERIMENTAL INOCULATIONS.

The animals used for experimental inoculations were half-grown and grown guinea pigs. In order to guard against accidental infection of the locality, the animals were placed in glass jars, which in turn were placed in large crocks, the latter having been covered with wire-netting covers, upon which the earthenware covers were placed. When an animal succumbed to the inoculation it was carefully removed from the jar and immersed for some time in 1–1000 sublimate solution. The jar itself was filled with a similar sublimate solution and the two left in contact for several days.

After subjecting the animals to necropsy they were placed in the steamer and thoroughly steamed, after which the body was incinerated. Such portions of the tissue as were preserved for microscopical study were placed at once in 95 per cent alcohol.

Inoculations were made subcutaneously with bits of tissue from the human cases and pure cultures of bacilli obtained from these sources. The usual procedure was to inoculate at least 2 animals from each human case; one with portions of the spleen and another with portions of the lymph glands. The cultures used were derived indifferently from the spleen and from the glands.

The inoculated animals can be separated into groups, depending upon the results of the inoculation. These results in turn depended upon the virulence of the material—tissue or culture—inoculated, upon which also depended the duration of life following inoculation.

It is important to state that characteristic lesions were obtained from inoculated material derived from every case in which bacilli were found in cover-slips, including case 7, in which very small numbers of bacilli were detected in the spleen.

Types of infection.—The animals inoculated early in the course of the investigations died at periods varying from forty hours to eight days. Those inoculated later, and one or two inoculated with cultures early in the studies, but which have not succumbed, were etherized at the close of the work and subjected to post-mortem examination. According to the period of survival and virulence of the inoculated material, the appearances observed denoted (*a*) bacteræmia without microscopical localization in the organs and (*b*) focal, nodular localizations in the internal organs. In all cases marked local lesions at the site of inoculation and in the adjoining tissues occurred.

Local lesion.—At the point of inoculation the tissues—skin, subcutaneous tissue, and sometimes muscles—were infiltrated with pus cells and presented a yellowish focus of necrosis. From this area as a center, the subcutaneous tissue, sometimes of one side, but frequently of both sides, was occupied by gelatinous hemorrhagic infiltration.

The lymphatic glands of the inguinal and axillary regions were distinctly enlarged even in the acute cases. In those animals which died after a longer period or were killed from six to seven days after inoculation the regional lymphatic glands were much enlarged, hemorrhagic, and even necrotic. The inguinal glands were, as a rule, more swollen than the axillary.

Cover-slip preparations from the local lesion—necrotic area, subcutaneous œdema, swollen lymph glands—showed large numbers of bacilli, having the characteristic morphology, staining, and reaction to Gram's method of the B. pestis. Cultures from these sources gave positive results.

In one animal in which the inoculation was made with a culture, the animal being etherized on the third day, there was slight local reaction only, no involvement of the regional lymph glands and no visible lesions in the internal organs having been observed. A small number of characteristic bacilli were found in cover-slips made from the site of inoculation.

The spleen and liver.—In the instances of rapid death (bacteræmia) the spleen was moderately large, its color was deepened, its consistence decreased, but no focal lesions were visible to the naked eye. Cover-slips and cultures showed numerous bacilli agreeing in characteristics with those of B. pestis.

In this class of cases the other organs failed to show focal lesions. The lungs appeared mottled only, and a few small necroses existed in the liver; numbers of bacilli were contained in all the viscera and in the heart's blood.

The focal lesions in the spleen consist of grayish-white nodules, larger than a millet seed in size, covering the surface (within the capsule) and occupying the substance of the organ; when the nodules are numerous, as, *e. g.*, in animals succumbing from the sixth to the eighth day, or after etherization at that period, when there has been a marked local reaction, the spleen is greatly enlarged, perhaps five to six times its normal size, and its color is pale. Cover-slips and cultures show a very large number of characteristic bacilli if the animal has died spontaneously, while if killed the number of bacilli upon cover-slips and cultures is far less.

The liver invariably showed lesions when death had been delayed a few days. The common ones were focal necroses of varying size. These were yellow in color, and in size ranged from that of a pin's point to linear and wedge-shaped areas 3 to 4 millimeters in length. Only rarely did whitish nodules similar to but smaller than those occurring in the spleen occur. The best example of nodular lesions in the liver was observed in an animal inoculated with a culture derived from case No. 1, the guinea pig having been etherized on the eighth day after inoculation.

The lungs.—The lungs presented a variety of appearances, only one of which was characteristic. Sometimes they showed no microscopical lesion; not uncommonly they were mottled and presented small ecchymoses beneath the pleura; rarely they contained scattered whitish nodules resembling those of the spleen, except that they were smaller and surrounded with a zone of recent hemorrhage. No effusions into the pleuræ were noted.

Subserous hemorrhages.—These were common especially in the peritoneum, where they occurred beneath and within the serosa of the large intestine, and in the pleura covering the lungs. They were usually small in size, although, at times through confluence, they reached larger dimensions. They did not give rise to an exudate or effusion into the serous cavities.

The other organs, except the adrenal glands, showed no especial changes to the naked eye. The adrenals were uniformly congested and often very dark in color and hemorrhagic.

The central nervous system was not examined.

BACTERIOLOGICAL EXAMINATIONS.

Case 1.—Chun Ah Chou, 814 Washington street; necropsy February 5. The spleen and left femoral glands were examined. These organs were found to contain enormous numbers of bacilli, having the morphological and tinctorial properties of bacillus pestis; thus, the short, thick, oval rods gave a bipolar stain with Loeffler's methylene blue or with carbolic thionin and were decolorized by Gram's method. Their pathogenicity was determined by inoculation of portions of the spleen and of a pure culture, subcutaneously, into guinea pigs.

Agar streaks made from the perfectly fresh organs showed many small, white, moist, isolated colonies, having all the appearance of those of bacillus pestis. This was further confirmed by microscopic examination of living and stained preparations of such cultures. A few rapid-growing colonies due to other forms of bacteria were present. Subcultures were made in glucose, gelatin, bouillon, agar, salt agar, and milk. On agar in Petri dishes in twenty-four to forty-eight hours in the incubator, small, white or grayish, moist colonies developed. These had finely granular center, with a smooth, sharply defined border.

The stab culture in glucose gelatin developed a slight growth along line of inoculation. On the surface the growth spread slightly, was grayish, moist in appearance, and had a slightly wavy, raised border. No gas was formed.

In bouillon, in twenty-four hours, a diffuse cloudiness was produced. The sediment was very slight, scarcely appreciable. Subsequently, a faint stringy deposit formed. The surface remained perfectly clear with a trace of a ring or collarette.

The streak cultures on nutrient agar presented a moderate grayish white moist growth which, when touched with a platinum wire, could be drawn out into strings.

On 5 per cent salt agar the growth is very slight, scarcely visible, and shows the peculiar roundish or pyriform involution forms of the pest bacillus.

In milk the organism grows without producing any visible change in the medium.

The absence of gas production and of coagulation of milk, together with the macroscopic and microscopic characteristics, agreed fully with the characters of bacillus pestis. The effects on animals have been described in a preceding part of the report.

Guinea pig No. 1.—Was inoculated under the skin with a portion of the spleen from the above case. It died in thirty-six to forty hours. Cultures on agar made from the spleen and heart blood gave almost pure growths of the pest bacillus. Direct examination of the organs showed enormous numbers of typical plague bacilli.

Guinea pig No. 2.—Was inoculated subcutaneously with a pure culture obtained from the gland of above case. The animal died in three days. Plague bacilli were very numerous in the spleen and inguinal glands, and were also present in the heart's blood.

Case 3.—Lum Hong Huen, 28 Ross alley; necropsy February 6. Smear preparations from the spleen showed large numbers of short, thick rods, chiefly single; some oval or roundish forms were also present. The organisms stained readily with Loeffler's methylene blue or with carbolic thionin. In the latter case the bipolar staining was excellent. The organisms were completely decolorized by Gram. Cover-glass preparations from the gland likewise showed very numerous bacilli, occurring singly, taking the bipolar stain, but not that of Gram. Agar cultures were made at the time of the necropsy in the undertaker's shop of Main Fook. The cultural and morphological characteristics were the same as those observed in case 1.

Guinea pig No. 3.—Received subcutaneously a portion of the spleen from above case; died in five and one-half days. On autopsy, the spleen was found markedly enlarged, full of white nodules which were also present in the liver and in the lungs. Cover-glass preparations from the spleen showed enormous numbers of bacilli, having all the characteristics of bacillus pestis. Agar slants were inoculated with the heart's blood and spleen of this animal. The former yielded a slightly contaminated growth, but the culture from the latter was pure.

Case 5.—Wong Chi Lui, 21½ Waverly place; autopsy February 7. Streak preparations from the spleen showed very numerous pest bacilli apparently in pure culture; the predominating form was the short, thick rod, although some oval or roundish forms were present. Loeffler's methylene blue and carbolic thionin stained the bacilli readily, demonstrating the characteristic bipolar form. The organisms were completely decolorized by Gram. Similar preparations made from one of the left femoral glands show fewer organisms, but these in form, size, and staining reactions are identical with those found in the spleen. Cultures made on agar developed very slowly; on subsequent transplantation, however, the growth was more rapid, more abundant, and typical of that of bacillus pestis.

Guinea pig No. 4.—Was inoculated subcutaneously with a portion of the gland from the above case. Death resulted in three and one-half days. Bacilli were numerous in the spleen and corresponded in characteristics to those of the plague bacilli.

Guinea pig No. 5.—Was inoculated subcutaneously with a portion of the spleen; it was found dead three and one-half days later. Numerous plague bacilli were found in the spleen, heart's blood, and glands. Agar streaks from the heart's blood gave numerous small colonies of pest bacilli with a few larger colonies due to foreign organisms. The spleen gave numerous isolated small moist colonies, apparently a perfectly pure culture of the plague bacillus. Agar streak plates were made at the same time, and gave in twenty-four hours numerous minute colonies.

Guinea pig No 6.—A portion of the spleen from this case was introduced into the peritoneal cavity. Death resulted in four and one-half days. Pest bacilli were abundant in the internal organs and in the glands. Agar streaks from the heart's blood gave a very limited growth, while that from the spleen was scarcely visible. In this and several other instances, difficulty was experienced in starting the growth of the organism directly from the tissues. Once started, however, with subsequent transplantations, better results were obtained.

Guinea pig No. 7.—Was inoculated subcutaneously with a loopful of a pure culture obtained from guinea pig No. 5. It died in two and one-half days. Necropsy revealed a hemorrhagic œdema, and cover-glass preparations of this showed pest bacilli mixed with numerous minute diplo and streto cocci. The spleen was large and soft, contained nodules, and on staining cover slips therefrom, enormous numbers of typical plague bacilli, apparently perfectly pure, were found. No diplococci were present.

Case 6.—Tom Shom, 814 Washington street; necropsy February 11. During life some fluid was aspirated by means of a sterile syringe from the swelling in the right femoral region and transferred to nutrient agar. Blood was also drawn from the lobe of the ear and planted on agar. Stained preparations made from these specimens failed to demonstrate the presence of any organism. Cultures developed pyrogenic cocci, but failed to give any indication of pest bacilli. On necropsy, the femoral glands, though characteristic of plague, were found not markedly enlarged. It was evident that the aspirating needle, when introduced, had missed the gland proper, and the failure to isolate the pest bacillus during life in this can thus be explained. It should be noted that the periglandular tissue was but very slightly involved. Streak preparations made from the hemorrhagic gland showed relatively few typical plague bacilli. A long, thick bacillus was present in small numbers. Gram's stain was negative. Streak preparations from the spleen showed the pest bacillus to be present in large numbers and apparently pure. The organisms occurred singly, gave the bipolar stain, and were decolorized by Gram.

Guinea pig No. 8.—Was inoculated subcutaneously with a portion of the spleen from this case. Six and a half days later, though healthy in appearance, it was killed. A circumscribed caseus local lesion was found. There was a slight glandular enlargement on the same side. The spleen was slightly enlarged and showed white nodules. Pest bacilli having the short-rod and oval form were present in small numbers.

Case 7.—Fong Ah Fong, 747 Sacramento street; necropsy February 12. Streak preparations from the spleen revealed the presence of pest bacilli, although these were not very abundant; indeed, they were difficult to find in cover-slips. Typical bipolar staining rods and oval roundish forms were, however, found. Gram's stain was negative.

Streak cultures were made with the fresh spleen on agar slants, and at the same time agar plates were made. The agar streaks failed to give an appreciable growth, but on the plate a colony was found which corresponded to that of the plague bacillus. On microscopic examination it was observed to consist of small, short, oval, nonmotile rods, which decolorized by Gram. The colony transplanted to agar gave a typical growth of pest bacilli, and this culture was used to inoculate guinea pig No. 10.

Guinea pig No. 9.—Received a portion of the spleen of Fong Ah Fong subcutaneously. It died in four and one-half days. The spleen contained enormous numbers of pest bacilli, which stained in the usual bipolar manner and were decolorized by Gram. The heart's blood likewise contained the organism. Cultures were made on agar from the spleen and heart's blood of this animal; both gave numerous small, moist colonies of bacillus pestis.

Guinea pig No. 10.—Was inoculated subcutaneously with the agar culture mentioned above. It was killed two and one-half days later. The spleen showed only a few but characteristic pest bacilli. Under the skin there was but slight local change and a few typical bacilli were found.

Case 8.—Ung Ah Buck, St. Louis alley; necropsy February 12. Cover-slip preparations from the cervical lymph glands showed the presence of several distinct organisms. The short, thick, oval forms of the pest bacillus were present in small numbers. With them was associated a large thick bacillus; there were also bacilli present resembling the bacillus diphtheriæ and a diplococcus closely resembling that of Fraenkel. The pest bacilli gave the usual bipolar stain with methylene blue and with carbolic thionin. Specimens stained by Gram's method showed deeply stained diplococci, the other forms being decolorized. Smear preparations from the spleen showed many organisms resembling the bacillus pestis morphologically.

Agar streaks from the fresh spleen gave a number of discrete moist colonies which consisted of large, oval, nonmotile bacilli, occurring singly and only occasionally in pairs; the streak cultures from the cervical gland also gave numerous isolated colonies. In both cases the cultures obtained were apparently perfectly pure and agreed in every respect with those of plague bacilli. The other bacteria seen in cover-slips did not grow. Agar plates yielded the same results.

Guinea pig No. 11.—Was inoculated subcutaneously with a small portion of the spleen from above case. In about three days the animal was very sick and was finally killed five and one-half days after inoculation. Bacillus pestis was found in the spleen and to a less extent in the blood.

The bacteriological examination of the foregoing 6 cases has, therefore, demonstrated the presence of the bacillus pestis in each.

SIMON FLEXNER,
F. G. NOVY,
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The SURGEON-GENERAL, *U. S. Marine-Hospital Service.*

No.	Name.	Age.	Sex.	Color.	Place of death.	Date of death, 1900.
1	Wing Chut King	41	Male	Mongolian	1001 Dupont	March 6.
2	Chu Gan	22	....do	.....do	723 Sacramento	March 15.
3	Ng Ach Ging	37	....do	.....do	905 Dupont	March 17.
4	Lee Sun King	47	....do	.....do	Oneida place	March 18.
5	Law An	38	....do	.....do	St. Louis alley	April 24.
6	Lim Fa Muey	16	Female	.....do	739 Clay street	May 11.
7	Chu Sam	38	Male.	.....do	717 Jackson	Do.
8	Chin Moon	16	Female	.....do	730½ Commercial	May 13.
9	Her Woon Jock	53	Male	.....do	740 Pacific	May 14.
10	Dang Hong	40	....do	.....do	706 Pacific	May 29.
11	Chen Kney Kim	49	....do	.....do	819 Clay	June 2.
12	Jay Man Tong	60	....do	.....do	759 Clay	June 9.
13	Lee Wing Tong	40	....do	.....do	767 Clay	July 6.
14	William Murphy	34	....do	White	427 Dupont	August 11.
15	Ham Tan	29	....do	Mongolian	900 Dupont	August 15.
16	Lea Do Heu	50	....do	.....do	710½ Dupont	October 5.
17	Chun Yen	37	....do	.....do	767 Clay	October 10.
18	Taik Dong Leong	39	....do	.....do	705 Clay	October 14.
19	Young Moon Li Chee	30	Female	.....do	802 Dupont	October 31.
20	Young Wah Noui	9	....do	.....do	802 Dupont	November 1.
21	Anne Roede	28	....do	White	Pacific Hospital	November 3.
22	Lee Ho	30	Male	Mongolian	844 Washington	December 7.
23	Chun Wey Lung	60	....do	.....do	780 Jackson	January 6, 1901.
24	Leam Wing Low	59	....do	.....do	633½ Clay	January 15.
25	Angela Colombo		....do	White	5 Lafayette place	Do.
26	Chun Ah Chou *a*	44	....do	Mongolian	814 Washington	February 5.
27	Lum Hong Yuen *a*	37	....do	.....do	28 Ross alley	February 6.
28	Wong Chi Lin *a*	50	....do	.....do	15½ Waverley	February 7.
29	Tom Shom *a*	51	....do	.....do	814 Washington	February 10.
30	Ng Ah Back *a*	45	....do	.....do	St. Louis alley	February 11.
31	Foong Ah Fong *a*	12	Female	.....do	747 Sacramento st	February 12.

a Observed by commission.

NOTE.—Particular places of death of following numbers were as indicated below: No. 8, Pacific Hospital, Stockton and Chestnut streets; No. 13, City and County Hospital; No. 14, City and County Hospital; No. 21, Children's Hospital, 3700 California Street; No. 25, City and County Hospital.

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